TECHNOLOGY DEPT.

THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

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DETROIT

SECOND SPECIAL CONFERENCE ISSUE

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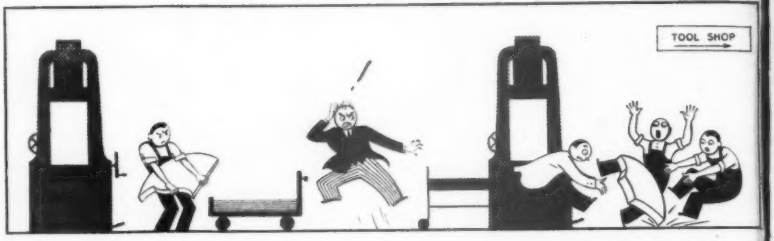
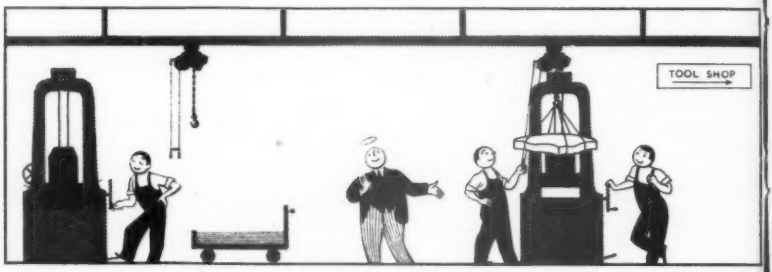
Everything happens in *some* factories



(Above) **IDLE MACHINES,** unavoidable fatigue and accidents are part of the real cost of out-of-date handling. It tends to make its mark in the balance sheet when goods are heaved and humped about by hand.

(Below) **WHAT A DIFFERENCE** when lifting and shifting are *organised*, part of a smooth production flow! Nearly always it means more production, less effort, lower cost per unit.



YOU'RE PAYING FOR A MODERN HANDLING SYSTEM whether you have it or not! Replace all the humping and heaving with modern materials handling gear and you save all along the line. A well-planned installation quickly pays for itself and goes on saving time, money and effort year in year out.

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You will find in KING booklets many useful ideas about Overhead Conveyors, Floor Conveyors, Travelling Cranes, Electric Pulley Blocks and Runways. Look into this; there's no obligation except ours—to help you speed output and cut costs.

Here is a KING Dual Conveyor on the job in a famous nut and bolt factory. Note the special tip-bins.

Refrigerators travel from Assembly to Dispatch Stores on a KING wooden slat floor conveyor in the Frigidaire factory.

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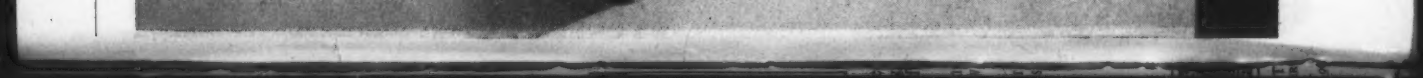

Pressure die castings in aluminium alloy form the major body components of the "Flamemaster" hand torch illustrated here by courtesy of Messrs. Chance Bros. Ltd. Our customer says: "The aluminium die castings which we have obtained from you for use on this product have proved entirely satisfactory, and are a great improvement on the previous covers. It is in fact true to say that they save us considerable assembly cost due to their accuracy of fit and excellent finish." *Extract of letter from Messrs. Chance Brothers Ltd., Smethwick, Birmingham 40.*

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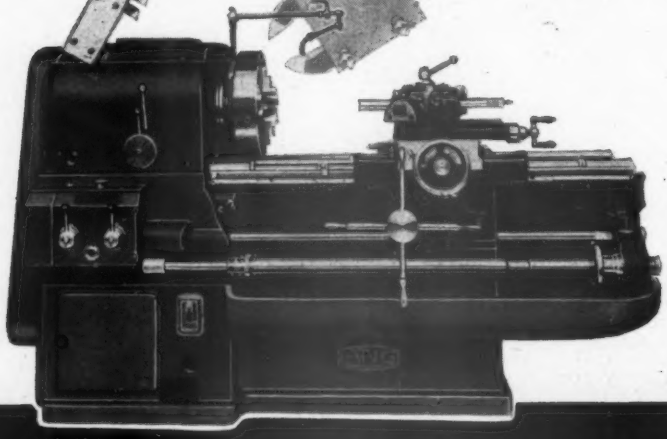

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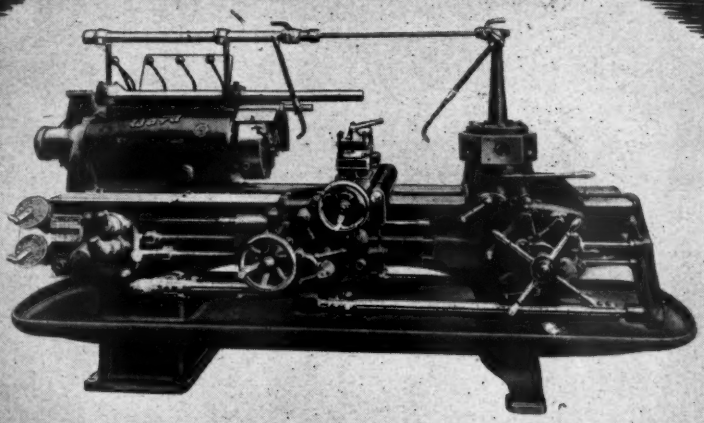

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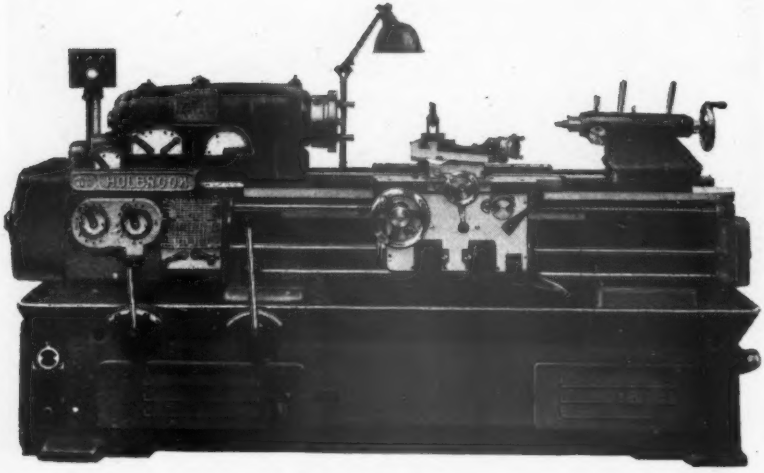

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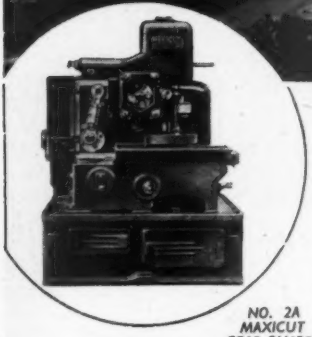

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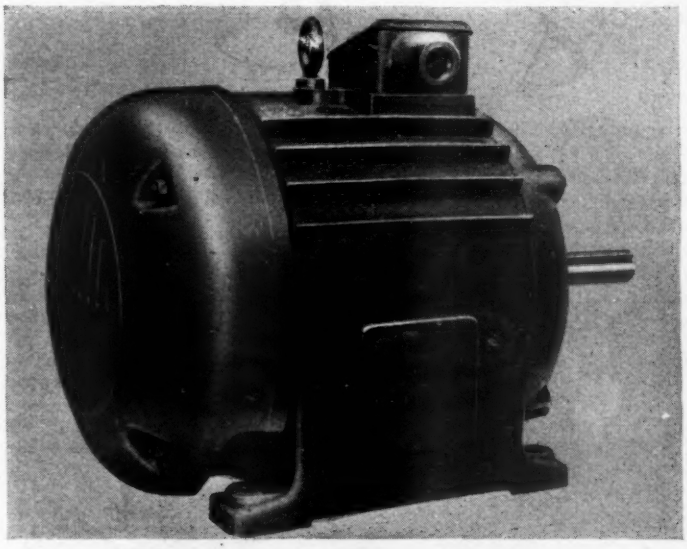

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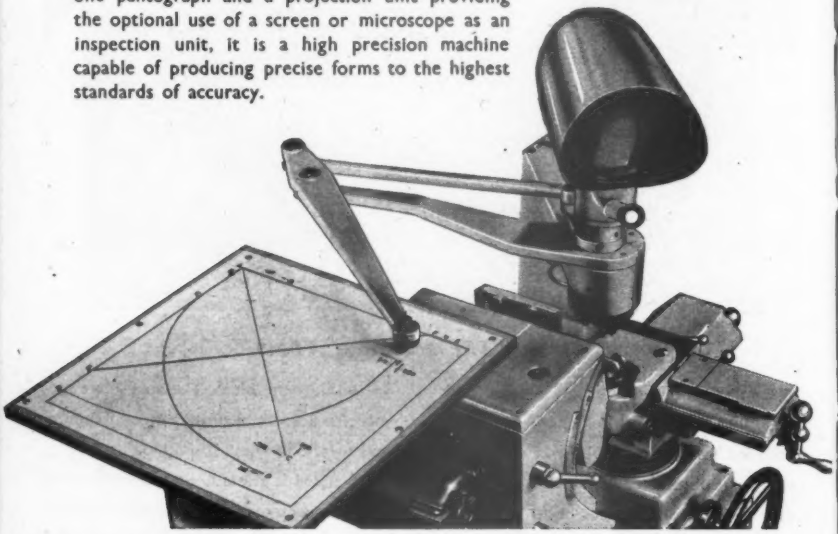

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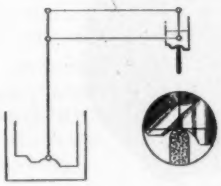

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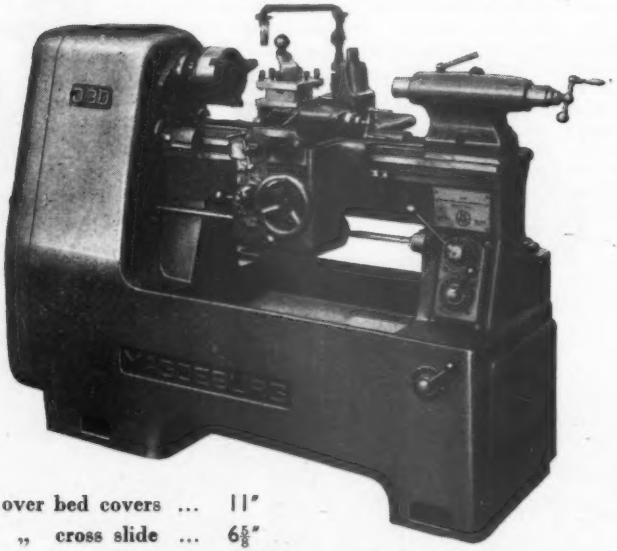

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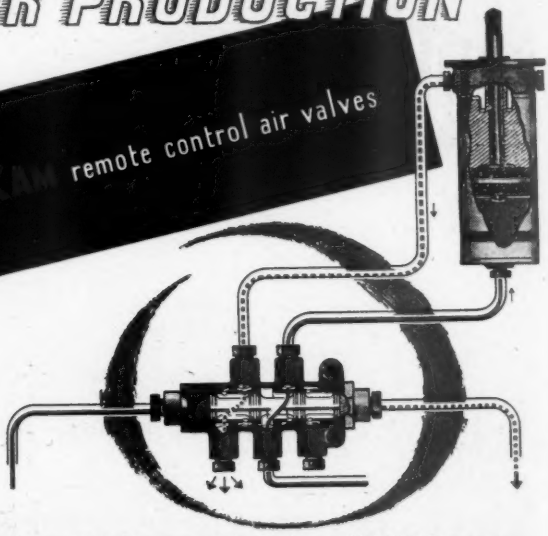

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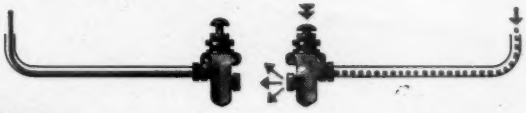

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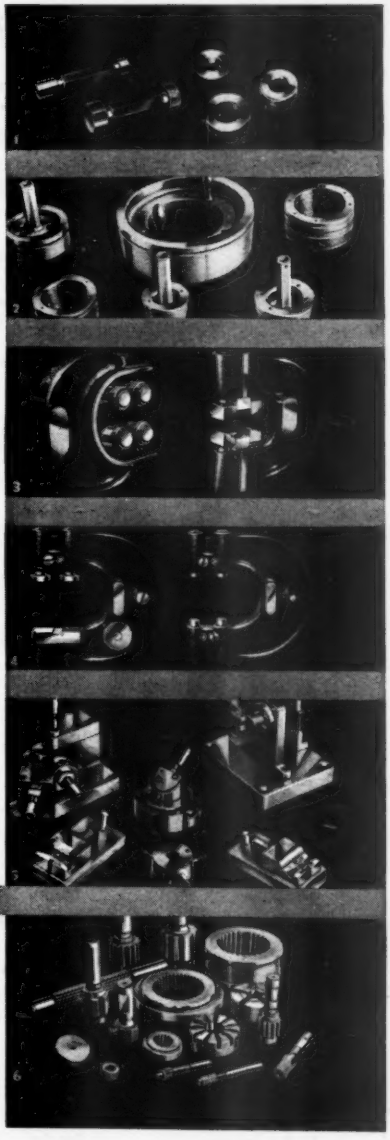

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THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

Vol. 30, No. 10, October 1951

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INSTITUTION NOTES

October, 1951

SCHOFIELD TRAVEL SCHOLARSHIPS, 1952 Graduates are reminded that the date for entries for the 1952 Schofield Travel Scholarships is Monday, 15th October, 1951.

Full details of the conditions and procedure may be found in the September 1951 issue of the Journal.

SOUTH AFRICAN BRANCH PRESIDENT'S AWARDS These awards, which are made annually for the best papers delivered to the South African Branch by a member and a non-member, will, this year, be presented to Mr. A. Hodge, Member, for his paper on "Some Aspects of Deep Drawing Presswork Practice," and to Mr. C. F. Lindskog for his paper, "The Oil Injection Mounting for Fitted Parts Requiring Interference."

DIAMOND TECHNOLOGY A series of ten lectures on "The Technology of Diamond and other Hard Substances" will be held at the South East London Technical College, Lewisham Way, S.E.4, on Monday evenings, commencing Monday, 8th October, 1951, from 7 to 9 p.m. The Fee for the Course is £1. 0. 0. This is a repetition of a similar Course which took place during the 1950/51 Session.

NEWS OF MEMBERS

Mr. A. Bassett, Associate Member, has taken up residence in Mt. Dennis, Ontario, and is engaged by A. V. Roe (Canada) Ltd., as Assistant Production Engineer.

Mr. G. E. Bausor, Associate Member, is now Superintendent, Aircraft Division, Cockshutt Plow Co. Ltd., Brantford, Canada.

Dr. S. Y. Chung, Associate Member, has been appointed Chief Engineer at the World Light Factory, Hong Kong.

Mr. L. P. Coombes, Member, is visiting Australia to study the development of K. D. Assembly of the Nuffield Organisation Products.

Mr. S. A. Cornish, Associate Member, is now Chief Planning Engineer with Frigidaire Ltd.

Lt.-Col. H. G. Good, M.B.E., Member, has left Korea Base and taken up the appointment of C.R.E.M.E., 1st Commonwealth Division in Korea.

Mr. H. Grafton, Dip.Ing., Associate Member, is now permanently residing in Sydney and has taken over the Management of the Technical Division of Lowatro (Aust.) Pty. Ltd.

Mr. K. H. Johnston, Associate Member, has returned to India where he is Manager, Allied Products, for the Goodyear Tyre & Rubber Co. of India, Calcutta.

Dr. D. R. Kinnell, Member, has taken up the position of Personal Assistant to the General Manager at Pratchitt Bros. Ltd., Carlisle.

Mr. L. G. Lacey, Associate Member, has been transferred to Young Accumulator Co. Ltd., Newport, Mon., as a Production Engineer.

Mr. N. A. Maskell, Member, is visiting the United States to make a brief tour of his organisation's associated factories in America with a view to studying their Time and Motion Study methods.

Mr. P. C. Miller, Member, has been appointed Chief Engineer of the Pakistan Ordnance Factories.

Mr. C. L. Mudge, Associate Member, has taken the position of Works Manager with Maley & Taunton Ltd., Wolverhampton.

Mr. C. L. Old, Member, has been appointed Principal of the Wolverhampton & Staffordshire Technical College.

Mr. F. N. Swindells, Associate Member, has been appointed Managing Director of Emerson & Renwick Ltd., Accrington.

Mr. F. W. Tweddell, Associate Member, has been appointed Deputy Principal at the Herts County Council Further Education Centre, Watford.

Mr. R. B. Allen Wright, Graduate, has joined Boving & Co. Ltd., as Contracts Engineer.

Mr. L. Bainbridge, Graduate, has been appointed Assistant Production Engineer with James A. Jobling & Co. Ltd., Sunderland.

Mr. M. L. Bentley, Graduate, is now Section Superintendent of the Power Press Shops, Feeder Works, G.E.C., Birmingham.

Mr. R. K. Gellatly, Graduate, has taken up the position of Production Equipment Designer with the Ford Motor Co., Dearborn, Michigan.

Mr. T. H. Jeens, Graduate, is Time Study Engineer in the Standards Office of Bakelite Ltd., Birmingham.

Mr. O. F. Rendell, Graduate, has won an E.C.A. Scholarship and is going to the United States to study at the Syracuse Univeraity. He will be away from this country for a year.

Mr. J. Rogers, Graduate, has been appointed a teacher at the Forest of Dean Mining & Technical School, Cinderford.

Mr. R. J. Vale, Graduate, is now a Production Study Engineer to the British Oil & Cake Mills Ltd., London Branches, Erith Mill.

Mr. J. Walker, Graduate, is now employed by the Ministry of Supply Royal Ordnance Factory, Leeds, as Shop Manager of the Production Machine Shops, Heat Treatment Department and the Electro-Deposition Department.

JOINT COMMITTEE FINAL REPORT on "MEASUREMENT OF PRODUCTIVITY — APPLICATIONS and LIMITATIONS"

The Joint Committee of the Institute of Cost and Works Accountants and the Institution of Production Engineers have now issued their final Report on "Measurement of Productivity— Applications and Limitations." The Committee's earlier investigations were recorded in the Interim Report on Productivity Measurement published in December, 1949.

The Final Report comprises three sections and two appendices : Part I — Productivity ; Part II — Methods of Measurement ; Part III — Conclusions and Recommendations ; Appendix 'A'— Machine Utilisation ; Appendix 'B' — Presentation of Information at Supervisory Level.

Coming at a time when the full and efficient utilisation of the resources of production is of the greatest national importance, this report is of espeçial interest. Copies may be obtained, price 2/- post free, from the sole distributors : Gee & Co. (Publishers) Ltd., 27-8, Basinghall Street, London, E.C.2.

HAZLETON MEMORIAL LIBRARY

The following publications have recently been received and are available to members. It would be helpful if the volume classification number could be quoted when borrowing books.

ABSTRACTS

651 OFFICE ORGANISATION AND METHOD

Office Management Association, London. Office Systems, Vol. 1. *The Association, London, 1951. 84 pages, tables.*

This volume contains a collection of four papers on Office Systems, each of which comprises a comprehensive survey available to the Office Manager in connection with the clerical function concerned. These papers are: "The Application of Planning to Sales Ledger Systems" by V. G. Reid; "Bought Ledger Systems" by A. Bradley; "Stores Control Procedures" by H. H. Norcross; "Wages Procedures" by A. Abbott.

The collection of these papers has been carried out in order to provide a text book for the information of managers wishing to review their systems, and for the guidance of students embarking on an office management career. The basic methods for each of the four functions are described in conjunction with the machines and equipment employed. In addition, there are a number of useful and informative appendices, charts and diagrams.

621.746 CASTING

"Die Casting" by H. H. Doehler. *McGraw-Hill, New York, 1951. 502 pages, illustrated, diagrams.*

A detailed work on the pressure die casting process which deals with every phase and operation required to supply a finished component from a customer's drawing. Chapters deal with design and operation of die casting machines, from the early hand operator plunger type to the latest electric and hydraulically operated submerged plunger and cold chamber machines, actuating mechanisms for movable die members, core actuating and locking devices, and general details of die design. The theoretical and practical aspects of die casting are discussed, including practical analysis and control of casting variables. Component design for economy of production and comparison with other processes, and die steels and their treatment are expounded. The metallurgy of tin, lead, zinc, aluminium, magnesium and copper base alloys are explained, together with the effect of alloying constituents of the base alloys. Melting practice is discussed. The methods of finishing die castings in each of the alloys such as chromium electro-plating, organic finishes, coloured anodic oxide coatings and specialised finishes are explained. Machine shop data for die castings is included. The book concludes with safety precautions in the plant and a glossary of terms used in die casting. The whole is illustrated by photographs and diagrams.

621.9 MACHINE TOOLS

"Constant Pressure Lathe Tests for Measuring the Machinability of Free Cutting Steels" by F. W. Boulger, H. L. Shaw, and H. E. Johnson. *A.S.M.E. Transactions, July, 1949. Pages 431/446. Photoprint illustrated.*

This paper describes laboratory tests carried out on free cutting steels using a fixed lateral pressure on the tool, and determining the feed ratio which can be applied to different steels when using a constant surface speed. A special lathe was used with the tool carriage disconnected from the fixed feed mechanism, and means were provided to show a predetermined lateral tool pressure. A device was incorporated to record the number of spindle revolutions during a given distance of tool travel. Essentially the paper describes a laboratory experiment, and gives academic details of machinability of different steels worked at a constant surface speed.

510 MATHEMATICS

"Mathematical Solution of Engineering Problems" by J. Jennings. *Spon, London, 1951. 208 pages (Spon's Mechanical Engineering Series).*

This book has been produced for those who need guidance in the application of basic mathematics to practical problems in engineering. The method of illustration is by worked examples chosen from mechanical, civil, and production engineering. Stress is laid throughout on the value of approximations, and a number of examples illustrate methods of solution for a number of widely different problems.

Commencing with a fairly full treatment of The Analysis of Experimental Data, there are sections on Areas, Volume Centroids, and Moments of Inertia, Nomograms, Dimensional Analysis, Linear Simultaneous Equations, Periodic Phenomena, Statistical Methods and Problems involving Fractions and Integral Numbers. The treatment is claimed to be suitable for those whose knowledge of mathematics is confined to a fair knowledge of algebra and trigonometry, with elementary knowledge of differentiation and integration.

A short, pertinent bibliography is given, and a general index is provided, as well as Contents, Illustrations, and Index to Tables used throughout. General Mathematical Tables of Logarithms and trigonometrical functions are not included.

OTHER ADDITIONS

621.86 MATERIALS HANDLING

Benson, Earle G. **"Material Handling, its Objectives and Application."** A Paper presented before a Meeting of the Industrial Engineers' Association, 1947. *Chicago, A. J. Boynton.* 1947. *22 pages. Diagrams.*

Electric Industrial Truck Association, Philadelphia. **"Handbook of Material Handling with Industrial Trucks."** *Philadelphia, The Association.* 1950. *71 pages. Illustrated. Diagrams.*

Gaudreau, A. T. **"How Material Handling Influences Plant Layout."** [Paper] before Pittsburgh Mechanical Engineering Conference. 1947. *6 pages.*

621.9 MACHINE TOOLS

Dent, R. **"Production Engineering for Higher National Certificate. Vol. 1, Machine Tools."** *Lond., Eng. Univ. Press.* 1951. *366 pages. illustrated. Diagrams.*

Schoulepnikow, Michel P. de. **"Brief Survey of Swiss Automatic Lathes."** *Illustrated.* (*Swiss Technics*, No. 1, 1949 : *pages 30–37*).

Ward, H. W. & Co.. Ltd., Birmingham. **"Ward Capstan and Turret Lathes, Small Tools and Attachments."** *Birmingham, The Company.* [*n.d.*] *281 pages. Illustrated. Diagrams.*

655.3 PRINTING

Letterpress Printing Productivity Team. **"Letterpress Printing : Report of a Visit to the U.S.A. in 1950."** *Lond., Anglo-American Council on Productivity, for the Team.* 1951. *78 pages. Diagrams.* (Productivity Team Report.)

657. ACCOUNTANCY

Bradley, A. **"Bought Ledger Systems."** *Lond., O.M.A.* 1949. *20 pages.*

De Paula, F. R. M. and Others. **"Top Management and Accounting Control."** *Lond., B.I.M.* 1950. *15 pages.*

658. INDUSTRIAL ORGANIZATION AND MANAGEMENT

British Institute of Management, London. **"Industrial Management Book List."** *Lond., Nat. Book League.* 1950. *24 pages.*

Hume, H. N. **"Management and the Financier,** [with] **Management in Private Enterprise and Nationalized Industry,"** [by] Sir Miles Thomas. *Lond., B.I.M.* 1949. *24 pages.* (Conference series 2).

Rodgers, Winston and Others. **"Standard Terminology."** *Lond., B.I.M.* 1949. *23 pages.* (Conference series 7.).

Institute of Industrial Administration, London. **"Reading List for the Institute's Examinations."** (Emergency Ed.) *Lond., The Institute.* 1950. *10 pages.*

658.5 PRODUCTION PLANNING AND CONTROL

American Management Association, New York. **"Organizational Teamwork in Production."** *New York, The Association.* 1949. *32 pages.* (Production series No. 184.).

American Management Association, New York. **"Quality and Expense Control."** *New York, The Association.* 1946. *24 pages.* (Production series No. 164.).

BRITISH STANDARDS The following Standards have recently been issued, and may be obtained post free at the prices stated, from the British Standards Institution, 24/28, Victoria Street, Westminster, London, S.W.1 :

327 : Part I : 1951	Power-driven Derrick Cranes (6/–)
1757 : 1951	Power-driven Mobile Cranes (6/–)
1759 : 1951	Knurling Wheels (3/–)
1764 : 1951	Nominal Diameters for Built-up Tins (1/6)
1782 : 1951	Hose Couplings (1½ in. to 8 in. nominal sizes) other than Fire Hose Couplings (5/–)

THE LIBRARY Members are asked to note that until further notice the Library will not be open on Wednesday evenings or Saturday mornings, but will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week.

JOURNAL BINDERS Members are reminded that binding cases for the Journal are obtainable from Head Office, price 7/6 each post free. The cases, each of which will hold 12 issues of the Journal, are made of stiff board covered with imitation leather cloth, with gilt lettering on the spine.

CHANGE OF ADDRESS It would be of great assistance to Head Office if members would ensure that the business addresses contained in their records were up-to-date, and would notify Head Office as soon as possible of any change of appointment.

RESEARCH PUBLICATIONS A number of copies of the following Research publications are still available to members, at the prices stated :

Report on Surface Finish, by Dr. G. Schlesinger	15/6
Machine Tool Research & Development	10/6
Practical Drilling Tests	21/-
Test Charts for Machine Tools, Parts 3 and 4	5/6 each

These publications may be obtained from the Production Engineering Research Association, "Staveley Lodge", Melton Mowbray, Leics.

ISSUE OF JOURNAL Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

REPORT OF

THE MEETING OF COUNCIL

26th July, 1951

THE first meeting of Council in the 1951-52 session was held at 36, Portman Square, London, W.1. on Thursday, 26th July, 1951. Mr. Walter C. Puckey, Chairman of Council, presided over an attendance of 30 Council Members. Also present were Mr. Charles Pullen of the Australian Sub-Council, and the Chairmen of the Coventry Graduate and Wolverhampton Graduate Sections.

Before proceeding with the business of the meeting, the Chairman welcomed the new Members of Council. He also welcomed Mr. Pullen and the two Graduate Chairmen.

REVISED FORM OF COUNCIL PROCEEDINGS The Chairman announced that, by the adoption of a revised form of Agenda, it is hoped in future to deal with all routine Council business in the morning, leaving the afternoon free for discussion on Institution general policy and development.

ELECTION OF PRINCIPAL OFFICERS On the unanimous recommendation of the F. & G. P. Committee, which was carried with acclamation, the following were re-elected for the year 1951-52 :

President : Major-General K. C. Appleyard, C.B.E., T.D., D.L., J.P.

Chairman of Council : Mr. Walter C. Puckey.

Vice-Chairman of Council : Mr. Harold Burke.

ELECTION OF STANDING COMMITTEES, 1951-52 Council elected the Standing Committees for the coming year, and a full list of Committee members is given at the end of this report.

Council expressed its deep appreciation of the valuable work done during their terms of office by Mr. J. E. Baty, retiring Chairman of the Standards Committee ; Mr. E. P. Edwards, retiring Chairman of the Membership Committee ; and Mr. A. L. Stuchbery, retiring Chairman of the Technical & Publications Committee.

ANNUAL BUDGET, 1951-52 The Secretary advised Council that since the draft Budget had been circulated, the Journal printers had requested an increase of approximately 10 per cent on the agreed charges. It was not possible to resist this extra charge

in view of the acknowledged rise in printing costs, but it was hoped to reduce its impact as much as possible by economies in other directions, and the Budget would be adjusted accordingly.

For the year 1950-51, there was a surplus of a little more than £2,000, after allocating £2,000 to the New Building Fund. For the coming year, as a direct result of inflationary pressure, a surplus of only £143 was forecast. The Secretary warned Council that the Budget was based on current prices, and any further increases in the cost of living might well confront the Institution with the possibility of a deficit. It was important therefore that the utmost care should be taken in all financial matters.

The sum of £1,200 had been allowed for Institution Papers. The establishment of these papers was a major step in the history of the Institution, to which the F. & G.P. Committee and the T. & P. Committee attached great importance. Sir Alfred Herbert, K.B.E., and the Right Hon. Viscount Nuffield, G.B.E. had both given permission for their names to be used in connection with these papers.

A sum of £500 had been set aside towards the salary and expenses of a Technical Officer, should an appointment be made during the coming year. Provision had also been made for assistance for the Librarian, since the postal work of the Library had exceeded all expectations.

SECTION EXPENSES The abolition of Section meeting tickets, which was proposed in the Budget, would effect substantial economies. It was proposed however to increase the amount allocated for Section expenses. It was generally agreed that a better purpose would be served by increased expenditure in the Sections than by continuing to print Section tickets. Visitors' tickets would of course still be printed. Alternative arrangements would be made to ensure that every member would receive adequate notice of Section activities.

APPOINTMENT OF TECHNICAL OFFICER The Chairman reported that representatives of all Standing Committees had met to discuss the terms of reference for this appointment. In view of rising costs, however, it had been decided to defer this appointment for some months, and possibly for the whole of the present financial year.

MACHINE TOOL ADVISORY PANELS It was reported that nominations to serve on panels had been made by most Sections. The Chairman informed Council that considerable activity was in prospect, and the Ministry of Supply felt that members of the Institution could offer a great deal of advice and service.

JOINT CONFERENCE WITH B.I.M. Negotiations were proceeding for a one-day joint conference with the B.I.M. on the subject of "Problems of Production Management Arising from Rearmament."

LORD AUSTIN PRIZE, 1950 Council approved the award of the Lord Austin Prize for 1950 to Mr. G. N. Johnson, Graduate, for his essay "Production Economy in Aircraft Manufacture."

Council expressed concern that the number of entries for the Lord Austin Prize and for other Institution awards was disappointingly low, and the Secretary was asked to ensure that wider publicity was given to these awards.

READING SUB-SECTION Council agreed that the Reading Sub-Section be granted full Section status, with responsibility for developing the Oxford area.

ASSOCIATE MEMBERSHIP EXAMINATION It has been agreed by the Education Committee that Part II of the Associate Membership Examination will in future contain only one compulsory subject, namely Materials and Machines, and that candidates may select their three optional subjects from those listed.

JOURNAL The comments forwarded by Section Presidents and Chairmen, at the request of the T. & P. Committee, had now been carefully analysed, and it was apparent that the main body of opinion concerning the size, content, and presentation of the Journal coincided with the Committee's own general policy. It had been agreed to put into practice as soon as possible a suggestion that written discussion on published papers should appear in the Journal.

RESEARCH The Joint Committee on Measurement of Productivity had now almost completed its work on "Time Study Training" and "Machine Utilisation and Measurement of Efficiency of Processes."

MATERIALS HANDLING The Secretary reported that Mr. T. W. Elkington, of the Birmingham Section, had agreed to be Chairman of the Sub-Committee, and a team would be gathered round him from the Midlands, where the Sub-Committee would operate.

HAZLETON MEMORIAL LIBRARY Commencing with the June, 1951, issue of the Journal, a monthly accessions list was being published in addition to abstracts and reviews, in the hope that members will thus receive a more useful indication of the type of material contained in the Library.

I.PROD.E. IN AUSTRALIA Mr. Charles Pullen, Honorary Secretary of the Australian Sub-Council, reported to Council that members in Australia were most enthusiastic and loyal to the aims and objects of the Institution. Courses had been established at Sydney and Melbourne technical colleges as a result of close collaboration between the Education Committees of the Sections concerned, and the college authorities. The revised course in Production Engineering at Melbourne was in its second year, and fully met the Institution's examination requirements.

Mr. Pullen also expressed satisfaction, on behalf of Australian members, with the closer liaison achieved by the inauguration of a quarterly news letter from the Vice-Chairman of Council. This method of keeping overseas members in touch with Head Office activities was greatly appreciated. The Chairman of Council asked Mr. Pullen to take back to Australia the very best wishes of Council for the future.

OBITUARY The death of the following members was recorded with regret : T. H. Blackwell, A.M.I.Prod.E. ; E. Bonset, A.M.I.Prod.E. ; A. G. Gardner, M.I.Prod.E. ; F. Grover, Hon. M.I.Prod.E. ; W. R. Maurer, A.M.I.Prod.E. ; F. Plant, A.M.I.Prod.E. ; G. C. S. Seymour, Int.A.M.I.Prod.E. ; R. C. Thurman, A.M.I.Prod.E. ; E. W. Tipple, M.I.Prod.E.

DATE AND PLACE OF NEXT MEETING Owing to the incidence of the General Election, the next meeting of Council has been postponed until 8th November, 1951, and will take place at 36, Portman Square, London, W.1., at 11 a.m.

ELECTION OF STANDING COMMITTEES

The following Standing Committees were elected by Council to serve for the 1951-52 Session.

Finance & General Purposes Committee.

The President, Major-General K. C. Appleyard, C.B.E.
The Chairman of Council, Mr. W. C. Puckey.
The Vice-Chairman of Council, Mr. H. Burke.
The Chairmen of all Standing Committees.
E. P. Edwards.
R. C. Fenton.
J. E. Hill.
B. G. L. Jackman.
A. L. Stuchbery.
Dr. H. Schofield, C.B.E.

N.B. The Principal Officers (President, Chairman and Vice-Chairman of Council) are all members of all Standing Committees.

Education Committee

The Principal Officers.
R. F. Beaton.
Dr. W. A. J. Chapman.
F. W. Cranmer.
B. H. Dyson.
E. P. Edwards.
J. France.
B. G. L. Jackman.
Prof. T. U. Matthew.
W. E. Park (Chairman).
F. H. Perkins.
Dr. H. Schofield, C.B.E.
M. Seaman.
H. Teasdale.

Hazleton Mem. Library Committee

The Principal Officers.
J. E. Blackshaw, M.B.E.
*G. Cubitt-Smith.
W. Core.
R. Hutcheson.
H. L. Madeley.
D. H. Mason.
*H. G. Payne.
L. J. Saunders.
J. D. Scaife.
Rt. Hon. Lord Sempill, A.F.C. (Chairman).
*H. G. Shakeshaft.
*R. Thorn.
*G. C. Twine.
*J. C. Zelenka.

Membership Committee.

The Principal Officers.
R. F. Beaton.
F. W. Cranmer.
J. S. Daniels.
R. P. Eccles.
E. P. Edwards.
W. N. Ellerby.
L. R. Evans.
R. L. Paice (Chairman).
F. Osbourne.
Dr. H. Schofield, C.B.E.
J. Silver.
H. Teasdale.
F. V. Waller.

Research Committee.

The Principal Officers.
J. H. Bingham.
W. H. Brown.
A. J. Bullivant.
F. T. Dean.
B. H. Dyson.
T. W. Elkington.
F. G. English.
R. M. Evans.
Dr. D. F. Galloway.
P. Holmes.
Sir Lional Kearns, C.B.E.(Chairman)
Prof. T. U. Matthew.
S. W. Nixon.
F. T. Nurrish, M.B.E.
G. R. Pryor.
J. B. Robertson.
M. Seaman.
A. L. Stuchbery.
W. J. Webb.
F. Whitehead.

Technical & Publications Committee.

The Principal Officers.
L. Bunn (Chairman).
R. M. Buckle.
J. E. Burnett.
H. A. Chambers.
W. J. T. Dimmock.
A. A. J. Francis.
H. Grigg.
R. Hutcheson.
H. P. Jost.
R. Kirchner.
F. P. Laurens, O.B.E.
R. E. Leakey.
A. McLeod.
T. W. Price.
A. Roberts.
T. Robinson Kidd.
A. L. Stuchbery.
B. W. M. Wakefield, M.B.E.

Standards Committee.

The Principal Officers.
R. K. Allan.
J. E. Baty
L. P. Coombes.
J. A. T. Crump.
H. G. Gregory.
C. M. Holloway (Chairman)
K. J. Hume.
H. L. Madeley.
N. A. Maskell.
L. Mawer.
C. R. Whitaker.
W. E. Wright.

*Graduate members.

ELECTION OF MEMBERS, 26th JULY, 1951

The following were elected to membership by Council :—

Adelaide Section

As Associate Member :
M. Chilton.

Transfer :

From Associate Member to Member :
W. Gwinnett.

Birmingham Section

As Associate Members:
F. J. Lupton, W. Sidwell, C. M. P. Willcox.

As Graduates :
A. S. Brett, D. R. Brookes, W. G. McManus.

As Students :
D. F. Flitcroft, G. R. Ridgway, J. Thompson.

Affiliated Firm : Change of Affiliate Representative :
Deloro Stellite Ltd., ... J. S. Carter.

Transfers :

From Associate Member to Member :
J. A. T. Crump, H. J. Smith.

From Graduate to Associate Member :
W. D. Freight, A. A. Grimshaw, S. A. Jelly, J. D. Roberts.

Bombay Section

As Associate Members :
B. N. Gupta, H. Hood, M. B. Dhavale, S. Mahadevan.

As Associate :
P. V. D'Souza.

As Graduate :
S. G. Padhye.

New Affiliated Firm : Affiliate Representative :
Estrela Batteries Ltd. ... ... D. M. Shah.

Calcutta Section

As Member :
D. L. Deshpande.

As Graduates :
A. K. Sarkar, S. D. Singh.

As Students :
M. K. Bhargava, F. L. B. Burnett, S. H. Shah, S. Sundaram.

Cornwall Section

As Member :
F. L. Fletcher.

Coventry Section

As Members :
M. H. Hurst, E. M. Price, A. C. Swindle.

As Associate Member :
L. R. Yates.

As Graduate :
A. M. Ray.

Transfer :

From Intermediate Associate Member to Associate Member :
D. H. Mills.

FROM GRADUATE TO ASSOCIATE MEMBER :
F. P. Liebert.

Derby Section

AS MEMBER :
J. D. Pearson.
AS ASSOCIATE MEMBER :
L. W. Culling.
AS STUDENTS :
R. Barr, R. J. Rowley.
TRANSFER :
FROM ASSOCIATE MEMBER TO MEMBER :
A. G. Clark.

Dundee Section

AS ASSOCIATE MEMBER :
J. N. Low.
TRANSFER :
FROM GRADUATE TO ASSOCIATE MEMBER :
J. Barclay.

Eastern Counties Section

AS MEMBER :
S. Widdas.
AS STUDENT :
P. J. Eke.
TRANSFER :
FROM GRADUATE TO ASSOCIATE MEMBER :
R. H. Revett.

Edinburgh Section

TRANSFER :
FROM ASSOCIATE MEMBER TO MEMBER :
E. W. Barrell, R. Grant.
FROM GRADUATE TO ASSOCIATE MEMBER :
A. Atkinson.

Glasgow Section

AS ASSOCIATE MEMBERS :
G. O. Bickers, R. Gordon.
AS GRADUATES :
M. S. B. Cross, J. R. Graves.
AS STUDENT :
J. M. Ballantyne.
AFFILIATED FIRM : CHANGE OF AFFILIATE REPRESENTATIVE :
T. White & Sons Ltd. ... ... J. Kennedy.
TRANSFER :
FROM GRADUATE TO ASSOCIATE MEMBER :
R. A. Nichol.

Halifax Section

AS STUDENTS :
K. Bottomley, G. Harrison, D. Lawrence.
AFFILIATED FIRM : ADDITIONAL AFFILIATE REPRESENTATIVES :
David Brown & Sons Ltd. ... E. L. Chignell, L. Ellam.
TRANSFER :
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER :
G. Thompson.
FROM GRADUATE TO ASSOCIATE MEMBER :
J. Pearson, J. Rhodes.

Leicester Section

As Member :
R. M. Evans.
As Graduates :
T. A. O'Connor, E. G. Perrott.
As Students :
J. L. Dryden, R. O. Leeding.

Lincoln Section

As Graduate :
P. N. F. Gabb.

Liverpool Section

As Graduate :
C. R. Konar.
As Students :
J. Heaton, R. D. Mearns, M. Ringham.

London Section

As Members :
W. J. Morgan, H. McQueen.
As Associate Members :
J. E. Cook, M. E. Esner, C. W. E. Harman, R. A. Mason, D. E. Peerman, A. M. Powell-Tuck, L. A. Waller, E. Wood.
As Associate :
J. A. Young.
As Students :
P. R. Boon, G. Cheater, A. Christmas, N. Crawford, J. C. Crockett, L. O. H. Gay, A. Green, G. E. C. Knight, K. G. Knox, F. J. Rose, S. J. Salsbury, P. B. Woodrow.
Transfer :
From Associate Member to Member :
F. W. Mosey.
From Graduate to Associate Member :
M. J. Sargeaunt.

Luton Section

As Member :
P. S. Appleby.
As Students :
A. H. Aas, J. A. Anderson, G. F. Barclay, M. J. Berry, P. W. Bone, P. J. Christy, D. J. Dallaway, J. T. Dillon-Godfray, G. A. Dishman, D. M. J. Grinham, R. A. Guy, H. J. B. Hall, N. Hall, G. M. Hayden, M. J. Hemmett, I. L. Johnson, P. N. Malhotra, E. I. Martin, A. J. E. Maynard, P. D. Mitchell, P. W. Moles, J. A. Prettyman, R. D. Saha, P. A. L. Signorini, R. L. Tosswill, B. Walkington, F. P. Wallace, G. K. Woolmington.

Manchester Section

As Associate Members :
J. Bayes, E. Bretherick, A. E. Cowlishaw, F. Lees, J. E. Scrouther, J. G. Swindells, J. Waugh.
As Graduates :
L. L. Chadderton, H. T. Lossius.
As Students :
A. G. Broom, G. Pickavance.
Transfer :
From Associate Member to Member :
R. H. S. Turner.
From Intermediate Associate Member to Associate Member :
J. J. Southwell.

FROM GRADUATE TO ASSOCIATE MEMBER :
I. D. Corbett.
FROM STUDENT TO GRADUATE :
K. Radford.

Melbourne Section

AS ASSOCIATE MEMBER :
J. D. Wood.
AS GRADUATES :
B. H. Davies, S. Hall.
NEW AFFILIATED FIRM : NEW AFFILIATE REPRESENTATIVE :
W. B. Dick & Co. (Aust.) Pty. Ltd. ... F. C. Hall.

New Zealand Section

TRANSFER :
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER :
A. F. Noutch.

North Eastern Section

AS ASSOCIATE MEMBERS :
J. C. Blackett, H. J. Cheston, J. C. Hall, J. Taylor.
AS STUDENTS :
J. R. Dowie, B. Wright.
AFFILIATED FIRM : CHANGE OF AFFILIATE REPRESENTATIVE:
Reay Gearworks Ltd. ... ... J. F. Smith.
TRANSFER :
FROM STUDENT TO GRADUATE :
A. W. Lockwell.

Northern Ireland Section

AS ASSOCIATE MEMBER :
E. W. Midgley.
AS GRADUATE :
P. C. Bhattacharjee.

Nottingham Section

AS GRADUATE :
L. A. Marshall.

Preston Section

AS ASSOCIATE MEMBERS :
E. D. Green, J. R. Harwood, H. G. MacMillan.
AFFILIATED FIRM : CHANGE OF AFFILIATE REPRESENTATIVE :
Howard Bullough Ltd. ... ... H. Whitton.
TRANSFER :
FROM ASSOCIATE MEMBER TO MEMBER :
H. Kirkman.
FROM GRADUATE TO ASSOCIATE MEMBER :
J. Beresford.
FROM STUDENT TO GRADUATE :
H. Maden.

Reading Section

TRANSFER :
FROM GRADUATE TO ASSOCIATE MEMBER :
R. A. G. Welsher.

FROM STUDENT TO GRADUATE :
G. J. Aries.

Sheffield Section

AS MEMBERS :
H. Bowness, T. H. Phillipson.
AS ASSOCIATE MEMBER :
T. Cocking.
AS GRADUATE :
E. A. W. Louw.
AS STUDENTS :
D. Bertie, A. E. Maw, J. C. H. Newbitt, P. Robinson, D. Wood.

South Africa Section

AS ASSOCIATE MEMBERS :
T. H. Hunter, A. E. Lawrence.
TRANSFER :
FROM GRADUATE TO ASSOCIATE MEMBER :
H. Derbyshire.

South Essex Section

AS ASSOCIATE MEMBERS :
T. Collins, S. T. Ford, H. J. Gozzett.
AS STUDENTS :
S. E. Cameron, R. A. Kean.
TRANSFERS :
FROM GRADUATE TO ASSOCIATE MEMBER :
R. A. Bartholomew, B. G. Harris, L. J. Redwood.

Southern Section

AS MEMBER :
J. B. Turner.
AS STUDENT :
D. F. Philpot.
TRANSFERS :
FROM ASSOCIATE MEMBER TO MEMBER :
F. C. Cooke, J. W. Taylor.
FROM INTERMEDIATE ASSOCIATE MEMBER TO ASSOCIATE MEMBER :
J. K. L. Murray, L. H. Osborne.
FROM GRADUATE TO ASSOCIATE MEMBER :
K. E. Stainer.

South Wales Section

AS ASSOCIATE MEMBERS :
Z. Funt. L. Gunter, M. G. Lane.
AS STUDENTS :
K. Cornwall, W. M. G. Evans.

Stoke-on-Trent Section

AS STUDENT :
D. G. Paice.

Sydney Section

AS ASSOCIATE MEMBER :
R. J. Smith.
AS GRADUATE :
P. J. W. Cottrell.
TRANSFER :
FROM ASSOCIATE MEMBER TO MEMBER :
W. McMahon.

Western Section

AS MEMBERS :
F. W. Daniels, E. Poole.

As Associate Member :
F. R. Walker.

As Students :
J. R. Abraham, J. Arnott, J. E. Attwood, J. D. Bendall, D. E. Bose, C. J. Bowden, G. N. Butler, A. W. J. Campbell, J. P. Chandler, G. J. Clark, R. B. A. Dyer, D. K. Frankling, R. Friendship, W. Furlong, T. P. Griffiths, D. T. Harris, R. Hayward, M. D. L. John, D. G. Lewis, D. R. Lewns, J. Maltby, G. C. Pearce, I. H. Powell, D. J. Pugsley, R. F. C. Skuse, J. B. Sully, E. Thomas, M. A. Thompson, G. F. Vincent, R. W. Wall, K. J. Watts, A. M. Wring.

Transfers :

From Associate Member to Member :
E. F. Gilberthorpe, F. W. Marks.

From Graduate to Associate Member :
T. A. C. Williams.

West Wales Section

As Associate Member :
D. R. Smith.

As Graduate :
R. G. Whinfrey.

Wolverhampton Section

As Associate Member :
W. H. Telling.

As Graduates :
W. J. Longmore, H. E. Sleigh.

As Students :
E. J. Lownes, F. R. Malin, B. S. Woodhall.

Affiliated Firm : Change of Affiliate Representatives :
Macrome, Ltd. ... . R. A. Harding, P. N. Rogers.

Transfer :

From Graduate to Associate Member :
G. V. Marston, A. S. Sault.

Yorkshire Section

As Graduates :
S. K. Day, P. S. Kharas.

As Student :
A. Hoyle.

Re-instatement as Graduate :
J. Walker.

Transfers :

From Associate Member to Member :
G. A. Aldred, S. Dickinson.

From Intermediate Associate Member to Associate Member :
A. Everson.

From Graduate to Associate Member :
H. Wood.

From Student to Graduate :
K. S. Worthington.

No Section

As Associate Member :
P. G. Thomas.

Transfer :

From Intermediate Associate Member to Associate Member :
J. C. McDonald Woolhouse.

LOCAL SECTION REPORTS

Adelaide

Regular monthly lecture meetings have been held during the period under review. These aroused keen interest and have been particularly well attended, especially considering the small population of the State, and the standard of lectures has been high.

All Committee Meetings in this quarter have been attended by all members, and their enthusiastic co-operation is bringing results in the building up of the infant Section.

In less than one year, when the Section started with 3 Members, 8 Associate Members, 2 Intermediate Associate Members and 2 Graduates, the Section has risen to a membership of 33, consisting of 5 Members, 17 Associate Members, 2 Intermediate Associate Members, 3 Graduates, 1 Student and 5 Affiliated Firms. New applications are coming forward regularly and still larger numbers are likely to apply in the near future.

Numerous outside bodies and individuals have favourably commented on the Institution's activities, and the Committee feels that the successful drive for Affiliates will further assist in the building up of the Section. The Committee is looking forward with confidence to the future.

Birmingham

The Section concluded its comprehensive programme of lectures on 16th April, when Mr. F. G. English, deputising for Mr. Walter C. Puckey, read his paper, " Measurement Productivity ".

Attendances at Section lectures have been fairly consistent, and discussions at each meeting have been marked by the number and the high quality of the contributions.

A special meeting was organised on 25th April, in the Birmingham and Midland Institute, when Professor M. E. Mundel spoke on " Some Aspects of Industrial Engineering in the U.S.A.". Over 500 members and industrial executives from all parts of the Midlands attended to make this a record meeting, and provide a stimulating audience for Professor Mundel's survey of developments, methods and techniques in the U.S.A.

The Materials Handling Conference, held on Saturday, 9th June, concluded last session's activities. This Conference, as reported in the September Journal, was held in the Castle Bromwich Works of Fisher and Ludlow Limited, and was one of the largest and most successful gatherings organised by the Section.

The season's social activities concluded with a summer outing on Saturday, 16th June, which included a treasure hunt in the country between Stratford and the Cotswolds, and tea was followed by an evening's entertainment at the Ettingshall Hall Hotel.

Mr. T. Elkington, Chairman of the Section Research Group on Materials Handling, had the opportunity of reporting upon the work of the group at the Harrogate Conference.

Bombay

On the 28th March, 1951, the Annual General Meeting of the Bombay Section was held, at which the Section President, Col. C. Warren-Boulton, M.I.Prod.E., submitted his report on the Section's activities for the past year. The Section President reported, with extreme regret, the untimely death of Mr. W. R. Maurer, A.M.I.Prod.E., which took place in England on 1st March this year. Mr. Maurer had played a very important part in the formation of both the Calcutta and Bombay Sections, and it was felt that his death would undoubtedly prove to be a considerable loss to the Institution as a whole. The Section stood for a few moments in silence as a tribute to Mr. Maurer's memory.

The President reported on the very full and successful list of Section Meetings which had been held during the past year, and also produced statistics showing

the very satisfactory progress in membership which the Bombay Section had made since its inauguration. He also stated that he was expecting to leave India for the United Kingdom towards the end of May, and hoped to attend the Institution Conference to be held in Harrogate at the end of June.

The Inauguration of the " President's Prize " and the " Indian-Wild Barfield Award " was mentioned, and the Section President appealed especially to the younger members of the Bombay Section to come forward and contribute papers on production subjects to be read at Section Meetings.

At the conclusion of the Section President's address, the Section Committee for the year commencing 1st July, 1951, was elected. Col. C. Warren-Boulton, M.I.Prod.E., was then re-elected Section President for the coming year, this being his second term of office, and Mr. R. A. P. Misra, A.M.I.Prod.E., was elected Section Vice-President for the coming year. Mr. E. H. Y. Burden, M.I.Prod.E., was re-elected as Section Honorary Secretary, with his future duties to incorporate those of Section Treasurer also.

At the conclusion of the Annual General Meeting, the Sixteenth Meeting of the Bombay Section was opened, and Mr. R. A. P. Misra delivered a most interesting lecture on " The Development of Variable Pitch Propellers ". On the 11th May, a paper entitled " The Inhibition of Rust " was extremely well delivered by Mr. H. L. Norfolk.

On the 22nd July, 1951, Mr. S. G. Barbet, A.M.I.Prod.E., read a paper entitled " Originating and Controlling Factory Paper Work ". This subject was of the most intimate and direct interest to all Production Engineers.

Calcutta

During the quarter ending 30th June, 1951, two interesting meetings have been held. The Annual General Meeting of the Section was held on 12th April, at which new officers were elected for the coming year. During May, a paper entitled " The Education of a Production Engineer " by Mr. T. B. Worth, Education Officer of the Institution, was read to this Section by Mr. B. F. Goodchild, M.I.Prod.E. This Meeting was well attended, and an interesting discussion ensued.

Twenty-four applications for membership have been dealt with at the three Committee Meetings held. Two candidates appeared for the Associate Membership Examination which was held in Calcutta from the 21st to the 23rd May, 1951.

The Honorary Secretary, Mr. J. Warren-Boulton, M.I.Prod.E., departed on home leave at the end of May, and Mr. E. W. H. Scaife, Grad.I.Prod.E., was appointed to officiate in his absence.

Canadian

As a result of the initiative and enthusiasm shown by members resident in Canada and the U.S.A., a Temporary Committee has been elected to discuss the formation of a Canadian/U.S.A. Section, the Chairman being Mr. E. A. Young, A.M.I.Prod.E., and the Honorary Secretary, Mr. T. H. Beard, Stud.I.Prod.E.

The first social activity of this group took the form of an informal dinner held at the Royal York Hotel, Toronto, on the 8th June last, with the object of providing not only an opportunity for members in Canada and the U.S.A. to meet each other, but also to offer a friendly welcome to members from Great Britain who were visiting the International Trade Fair.

This was a most successful occasion, and will, it is hoped, be the forerunner of many others.

Dundee

The Annual General Meeting was held during this quarter, and Section Officers appointed. Mr. A. R. Gow, re-elected President, read a comprehensive President's report on the activities of the Section. Mr. Gow thanked the retiring Committee

for their loyal support, and especially referred to the enthusiasm and hard work of Mr. A. H. Webster, who had intimated his wish, due to absence on business, to relinquish the position of Section Honorary Secretary.

The Committee has discussed a balanced progressive lecture programme for 1951/52, covering all branches of Production Engineering from Workshop to Higher Management, including Works Visits. The question of better publicity was also discussed, and among other methods, it was decided to advertise all open Meetings.

The considerable number of professional engineering bodies in the district and the desirability of holding joint meetings was considered and the decision made that a joint meeting be held in a neighbouring township, but that, so far as Dundee was concerned, joint meetings should be left in abeyance.

Social outings and the possibility of an Annual Dinner are being investigated, and also a suitable subject for research, taking into consideration the nature of industry in Dundee.

Glasgow

An invitation was extended to all members in the Glasgow Section to attend the Royal Technical College Exhibition on the 1st and 2nd May, 1951.

In May, 1951, members of the Section visited the Works of British Olivetti Limited, Typewriter Manufacturers. The new factory has just recently started producing typewriters and the visit, which was well attended, proved to be most instructive. In June, members of the Glasgow Section visited the Glasgow Corporation Coplawhill Works. All Corporation Trams are built and overhauled at these works ; the visit was very interesting and was well attended.

Two Committee Meetings have been held during this quarter, and a special meeting was called to meet Mr. G. E. Knight, Assistant Secretary (Education and Membership), who gave the Committee some guidance as to the new membership qualifications.

Halifax

An excellent lecture entitled " The Economics of Foundry Mechanisation " was presented by the Vice-President of the Section to fill the February date. The evening held yet another attraction in the presence of Mr. T. B. Worth, Education Officer of the Institution.

The following day, Mr. Worth continued his very full programme and met the Principals of the Halifax and Huddersfield Technical Colleges, visited various firms in the district, and presented his lecture, " Graduate Status—Its Responsibilities and Implications," to the Graduates, one evening in Halifax and the next evening in Huddersfield.

The Annual General Meeting was held in March, when the President, Mr. I. G. Hopkinson, who has been re-elected for the coming year, gave a report of progress made, and in expressing thanks to the Committee for their support, made special reference to the Vice-President, Past President and Section Secretary for the work they had done during his absence abroad. Mr. F. M. W. Hird was then invited to give his lecture entitled " The Effect of Costs on Production Engineers " and this concluded general activities of the winter session.

Details for the 1951/52 syllabus are well in hand, and a new departure is a combined programme for Seniors and Graduates. Works visits are being arranged, and the Social Committee is at work in preparation for the Annual Dinner and Dance to be held in November.

An item to which all are looking forward is a report of the Valve Productivity Team's visit to America by the Section President and other members of the Team.

Leicester

Although the past quarter has been a slack one, as far as Section activities go, the Committee has been hard at work with preparations for the coming Session's

Lecture Programme which is now almost complete. The Section enjoyed a very successful afternoon's visit to PERA in June, and arrangements were made for the Section to visit the local telephone exchange during an evening in late August.

Following the extremely successful Annual Dinner in April, the Dinner Sub-Committee is already hard at work with the preparations for the next one, which promises to be an even greater success.

In welcoming two new members to the Committee, Messrs. S. Radcliffe and L. Houghton, the Section reiterates its thanks to the retiring members, Messrs. J. Rollings, E. W. Harbot and L. Carrington, for their services in the past.

Lincoln

Since the last report was submitted, a further two meetings have been held, the first of these, in April—being the Annual General Meeting—at which Mr. T. B. Worth, the Education Officer of the Institution, lectured on " An Assessment of Production Engineering Training ". Mr. Worth was in Lincoln for three days during the week in which the meeting took place, and visited the major engineering works and Technical College.

The Section Meeting held in May took the form of a visit to the works of George Blackburn & Son, Nottingham, Hosiery Machine Manufacturers.

In addition to the meetings on the Lincoln Section programme, a number of Lincoln Section members attended a meeting of the Nottingham Section, when three Lincoln members, who formed part of the Productivity Team which recently visited the U.S.A., gave a joint talk on their impressions of American productivity.

The Section is continuing to publicise the activities of the Institution in the Scunthorpe area and, as mentioned in the last report, two meetings have been arranged, one during the summer and the other during the winter, details of which are now complete. For the winter visit, the Education Officer has agreed to attend the meeting, it being understood that it is his intention to spend two or three days in the area visiting heavy engineering works and Technical Institutions.

The Section continues to do all possible to foster interest in the Institution in the Gainsborough area, which, as mentioned in previous reports, has been the subject of special attention and where considerable support has been obtained.

Liverpool

The Section Committee arranged an outing on Saturday, 8th September, into North Wales to visit, by kind permission of the Divisional Controller, British Electricity Authority, Merseyside and North Wales Division, the Maentwrog Hydro-Electric Power Station.

At a meeting held in April, the Research Sub-Committee discussed in detail the aspects of the " Average Operator " and " Rating Factor " in time study. The developments of time study were traced from the early beginnings of " Contract Piece Work " to present-day motion study, and a case was presented against the ' levelling by operator rating ' on the main grounds that the accuracy of the final standard was no greater than the accuracy of the observer's judgment. A 30 per cent method for obtaining true time factor from observed times was then outlined. During the discussion which followed, it was claimed that this latter method was applicable to " one off " and " small batch " production.

A great deal of time and thought has been given to the programme for the 1951/52 session, and in connection with the Common Subject it has been decided to contact firms on Merseyside and in North Wales and invite them to make contributions to this paper. The symposium will be read at the meeting on 20th February, and constructive criticism and discussion is expected to develop.

The Education Sub-Committee has reviewed education and training over a very wide field. Week-end schools held locally are recommended. It is believed that greater support would be afforded to lectures of the Section if local industry

were informed more fully of the aims of the Institution and the facilities which can be provided to apprentices and others in the realm of production engineering, through its educational courses.

London

(*Incorporating Reading, Rochester, and South-Essex Sub-Sections.*)

A main activity during the past quarter has been finalisation of the 1951/52 lecture programme which has to cover thirteen meetings of the main London Section. In addition, there are the meetings organised by the Rochester and the South-Essex Sub-Sections and those of the Graduate Section.

The Institution subject of component production with the minimum formation of scrap has been borne in mind and consequently there are papers covering high speed press work, drop forging and hot stamping, and resistance welding. The great success of the paper dealing with the building of a liner, last Session, has led to a similar paper on locomotive building.

It is interesting to note that matters emphasised at the Harrogate Conference as being important had already found places in the programme. The need for Production Engineers to have a knowledge of accountancy, the importance of training of men for responsible positions and the use of air-actuated tooling to aid machine utilisation, were all subjects which were deemed to be of importance to the Conference and which are being discussed next Session.

The success of the meetings held last session in Croydon and Brighton has resulted in the decision to hold meetings again in these centres.

Both the Rochester and the South-Essex Sub-Sections have formulated excellent lecture programmes for next session.

London was well represented at the Harrogate Conference—about seventy Londoners, many with their ladies; attended, and took an active part in the proceedings. The group discussion " How to Introduce and Apply Methods of Training for the Engineering of Production ", was sponsored by this Section.

Growth of membership has been steady, and although the percentage increase may not be extremely high, it is deemed to be satisfactory numerically and has included men of high standing in the engineering world.

Changes are taking place in the officers of the Section. Mr. W. Core retires from the Presidency and Mr. R. Kirchner has been elected as his successor, while Mr. Core retains his place on the Committee.

London Graduate

The Section lecture programme ended in May. It is gratifying to note that two of the most successful papers of the Session were presented by Graduates. The report of the London Graduate Section Materials Handling Study Group was the result of regular and well attended Group meetings over a period of about eighteen months. The paper was well planned and accompanied by suitable illustrations. Another paper of outstanding merit was presented by Mr. H. P. Jost, his subject being " Industrial Law and the Production Engineer ".

It is clear that, by careful preparation, a Graduate can present a first-class paper to the Section, and it is hoped that many Graduate members of the Section will undertake to prepare papers for the coming Session.

Several members of the Section are serving on the Hazleton Memorial Library Committee and have worked hard to establish the Library service of the Institution. They would, however, like junior members to make greater use of the library facilities.

Next season's programme will include several lectures on chipless processes of manufacture, the lectures will be arranged in a sequence that will enable continuity of thought. In deciding the Factory Visit Programme, an attempt was made to avoid visits to manufacturers of metal products only. It is thought that visits of a wider character can broaden the outlook of our members towards the scope of Production Engineering.

Luton

The programme for the next Session has been completed.

A visit to the Aeronautical College at Cranfield was arranged through the good offices of Professor J. Connolly, M.I.Prod.E., and the members taking part spent an instructive and very interesting afternoon. Many requests have been received for another visit to the College.

Manchester

The 1951/52 Lecture Programme terminated most successfully with Mr. Annis's lecture on " Steam Turbine Manufacture ".

The Syllabus Sub-Committee has completed arrangements for the 1951/52 Session, and is looking forward to a programme of exceptional variety and interest.

Consideration is being given to assisting the North West Regional Board for Industry in arranging a Productivity Exhibition early in 1952.

The Committee was unanimous in declaring the Harrogate Conference a great success, and thought that Mr. Woodford's staff should be complimented on their organising efficiency.

It is worth noting that, at the Conference, Mr. H. G. Gregory spoke on the " Status of the Production Engineer ".

Mr. R. H. S. Turner accepted the Committee's invitation to succeed Mr. A. Fraser as Section President, and the Committee was also pleased to welcome Mr. J. W. D. Taylor to the Committee in place of the retiring member, Mr. Veevers.

Membership growth is continuing steadily and it is hoped that the rate can be accelerated with the commencement of the next Winter Programme.

Melbourne

During the first quarter of 1951, the work of the Melbourne Section has progressed smoothly.

The first meeting in March was most successful and well attended. Mr. G. T. Pihl delivered a most interesting and instructive address to members, entitled " Anti-Friction Bearings in Machine Tool Spindles."

At the April meeting Mr. H. G. Sutton occupied the Chair in the absence of the Section President, Mr. W. M. B. Fowler, who was attending the Australian Sub-Council Meeting in Adelaide. Over 70 members and friends were present to hear the lecture entitled " The Foundations of Successful Production Planning ", which was given by L. W. Moorhouse, Esq., A.A.I.A., Lecturer, Production Management, Melbourne Technical College. Mr. Moorhouse was most stimulating in his vigorous and orderly treatment of a familiar subject, and members came away with a new light on many personal problems.

A very interesting visit was arranged for members to the State Electricity Commission Yallourn Brown Coal Project, in May. This visit proved an ideal prelude to the lecture by Mr. W. M. Morgan, Engineer for brown coal production of the S.E.C., the title of the lecture being " Brown Coal Production ". The lecture was beautifully illustrated by a coloured film and slides showing the activities of various projects in Australia, Germany, Great Britain and the U.S.A.

New Zealand

The first meeting for the year was held on 12th February, when a film on Gas Turbines was shown.

Several letters were received from overseas members, enquiring as to the general prospects of settling in New Zealand. The Secretary was instructed to reply to these and say that prospects were good here for first-class tradesmen, but rather limited for executive positions.

A meeting was held on 7th May, when a letter from Mr. H. Burke, Vice-Chairman of Council, asking for comments and suggestions for furthering objects

of the Institution, was considered. There was quite a keen discussion and some good suggestions were made. Afterwards, a well-produced film was shown dealing with the manufacture of automobile engine valves and spare parts by Thompson Products, America.

A Committee Meeting was held on 21st May, when members of the Committee were asked to approach several men whom the Committee judged would be interested in applying for membership in the Institution.

A tentative programme of meetings for the rest of the year was also drawn up.

The New Zealand Section is pleased to welcome the following members from overseas: Mr. J. Bonas, M.I.Prod.E., Mr. R. E. Green, Int.A.M.I.Prod.E., Mr. A. F. Noutch, Int.A.M.I.Prod.E.

North Eastern

As a General Meeting was not held during the period under review, the Committee has only met to deal with general subjects.

The programme of lectures for the 1951/52 session is now complete. Council has been requested to provide a senior speaker to give an uplifting lecture and to promote area productivity.

A Dinner Dance has been arranged for Wednesday, 12th December, 1951. This will be the first of its kind held by the Institution in this area.

A discussion has been held with the Ministry of Information on the subject of an area productivity exhibition.

North Eastern Graduate

During the last three months the activities of the Section have been confined to Committee members. There has been a good deal of discussion on the subject of next Session's programme, and an attempt is being made to provide a balance between Theoretical, Technical and Managerial Lectures.

In an endeavour to improve attendances at meetings, a number of the lectures will be given by men of experience, and those papers presented by Graduates will be vetted by the Committee before being read.

As a variation of the usual programme it is hoped to have a Brains Trust early in the session, the "Brains" being supplied by the Senior Section Committee, and the questions by the Graduate Section.

Sheffield

Apart from the arrangement of next season's programme, the Section Committee has been concerned with the working of the new membership regulations, relating to applicants under the age of 35, with particular reference to the Steel Industry and Heavy Engineering.

The Committee feels that the introduction of these younger men is vital to the Institution, and if the base of the Institution is to be "broadened" to cover the responsible Production Engineers who are operating plants on "hot work", and not primarily concerned with machine tools, then the subjects of the examination require modification.

With this in view, Mr. Worth paid a four-day visit to the Section, meeting the Committee and visiting typical plants in the district.

It was agreed that this matter should be raised again with the Education Committee.

South Africa

On the 5th April, 1951, Mr. P. S. Sear, a member of the Institution, delivered a paper entitled "The Practical Filtration of Water", and on the 1st May Mr. C. O. Doehring, M.Sc., M.I.Prod.E., delivered a paper entitled "Economy in Industry."

Professor W. J. Walker, M.I.Mech.E., Head of the Department of Mechanical Engineering, University of the Witwatersrand, read a paper to a combined

meeting of the Institution and the South African Branch of the Institute of British Foundrymen, entitled " Education Research and Production in the Engineering and Foundry Industries ".

On the 7th June, 1951, Mr. A. Hodge, a member of the Institution, delivered a paper entitled " Some Aspects of Deep Drawing Presswork ".

Southern

The outstanding event of the quarter was the Annual General Meeting, followed by a Dinner, on the 6th April, 1951, at which the principal guests were Sir Robert Wood, Principal of University College, Southampton, and Mr. Walter C. Puckey, M.I.Prod.E., F.I.I.A., Chairman of Council. In addition, a large number of local leaders of industry were present. This form of Dinner was a new venture aimed at influencing, and bringing the Institution's name to the fore amongst, local industries.

As from 1st April, 1951, the status of the Southampton Technical School was lifted to that of a College, and Mr. F. T. West, M.I.Prod.E., was appointed as its Principal. The Section also has been fortunate in having Mr. West elected as a new member of the Committee, together with Mr. D. L. Wiggins, Director of Industrial Technics Tool Designers, Southampton.

A further new venture during this month was a lecture by Mr. T. B. Worth, Education Officer of the Institution, to Students at the Portsmouth Technical College ; this was in addition to the usual lectures held at Southampton, and was regarded as an experiment for the Winter Programme. It was entirely successful, and over 100 students were present. It is, therefore, intended to hold a series of lectures in this area during the next season.

During June, the Committee had a meeting with Mr. Tuck, from Messrs. C.V.A. of Brighton, in connection with the formation of an Advisory Panel to assist Mr. S. W. Rawson, Director General of Machine Tools, and a list of suitable members for the Panel has now been forwarded to Mr. Tuck for his action.

Sydney

During the months of April, May and June, the Section has had three very interesting papers. The first, presented by Mr. C. M. Kennedy, A.M.I.Prod.E., on " Methods Time Measurement ", created much interest as was evident by the discussion which ensued later in the evening. The paper on " Copper Brazing and Furnace Assembly ", presented on 1st May by Mr. A. Livermore, proved extremely interesting, especially to those engaged in the refrigeration trade. On 5th June, Mr. B. B. Nettleton, B.E., presented a very good paper on " Modern Handling Equipment as an Aid to Better Production Economy ". On 10th April an inspection took place at the Cockatoo Docks and Engineering Company Pty. Ltd. Those attending were divided into two parties and were shown through every working section of the Island, and one of the highlights of the visit was an inspection of a " Daring " Class Destroyer under construction.

The strength of the Section membership at present totals 191.

New members have been added to the Sydney Section during the last quarter.

During the third week in May, an Engineering Production Convention took place when a series of papers were presented and visits took place to some of the leading plants in Sydney. The total registration for the Convention amounted to 460, and amongst these were many inter-state visitors. The Convention was organised by a Committee on which the Sydney Section was represented by two members.

Western

Arrangements for the Section Dinner and Dance are now well advanced, and the Committee is pleased to report that the President, the Lord Mayor and Lady Mayoress, the Sheriff and his Lady, have already accepted invitations to be present.

The programme for the 1951/52 session is now practically complete, and

members will be receiving notification in the usual manner. Some of the lectures arranged are outside engineering topics, and it is anticipated that members will find them of considerable interest.

Having received permission from Council to form a Graduate Section, the Inaugural Meeting took place on the 1st October, 1951, at the Grand Hotel.

The Section President for the new year is Mr. G. W. Wright. He has already served well for two years as Vice-President, and the Committee know the Section will continue to expand under his guidance. To the retiring President, Mr. R. S. Brown, the Section gives its best thanks for two years' hard work well done. Fortunately the Section is not losing Mr. Brown's services, or the benefit of his experience, as he is continuing as a member of the Committee.

West Wales

It was regretted that the visit to Viscose Development Company Limited, Swansea, scheduled for 6th April, had to be cancelled at very short notice for reasons of security. The Sub-Section is, however, greatly indebted to the Amalgamated Dental Engineering Company Limited, also of Swansea, who enabled an alternative and most interesting works visit to be arranged at a moment's notice.

At a meeting held on 18th May, it was resolved to plan the 1951/52 programme by following the usual practice, *i.e.*, (1) to incorporate three papers from the Institution list, (2) to have the Common Subject given by a non-member of the Institution, and (3) to have three papers of local interest from local industrialists.

It was agreed that as the new factories of the Steel Company of Wales are due to come into operation coincident with the next Session, the emphasis of the Section programme should be on Steel and the Steel Industry. The opening of these new factories is not only of local but of national interest, and it is hoped that arrangements can be made for visits by members of the West Wales Sub-Section.

From the educational point of view it is interesting to note that arrangements have been made by the Swansea Technical College to introduce a Higher National Certificate course in Production Engineering, and it is expected that full advantage will be taken of these facilities.

Wolverhampton

The last lecture of the 1950/51 Session was held at Dudley, when Mr. R. A Johnson's paper entitled " Modern Adhesives " was well received and provided a very good discussion.

Preparations are in hand for the 1951/52 Winter Session, and an extensive drive will be made with a view to increasing membership.

A Sub-Committee, with Mr. H. Corran as Lecture Secretary, has given much consideration to the question of venue and to the form of meeting. Following the Section's previous practice, meetings will be held in Wolverhampton, Dudley and Wednesbury.

The Materials Handling Conference arranged by the Birmingham Section was well supported by a party from Wolverhampton, and the Section wish to congratulate Birmingham on this effort.

The Summer Social Outing was arranged for 14th July, when the Section visited Malvern College, Worcs. Ladies joined the party on this occasion.

The Senior Committee wishes to draw attention to the report of the Graduate Section, and to thank its Committee for the enterprise shown by its members, especially during recent months.

Applications for membership continue to be received each month, and the Committee looks forward to meeting both old and many new members at the forthcoming lecture meetings.

Wolverhampton Graduate

During this quarter three lectures were held, " Press Tools " by Mr. J. A. Grainger, " Metrology " by Mr. G. H. Rutland, and " Industrial Economics " by Mr. C. Tragen. The two works to which visits were made were Orme-Evans Limited and The Villiers Engineering Co.

In an effort to draw the three Midland Graduate Sections together, a combined outing was arranged for 26th May. A party of 231 Graduates and friends of the Wolverhampton, Birmingham and Coventry Sections, travelled by coach to the South Bank Exhibition. Later in the day, a dinner took place at the Royal Horticultural Society's Hall, when Mr. R. V. Brown (Birmingham Graduate Chairman) and Mr. S. R. Tyler (Wolverhampton Graduate Chairman) were the speakers.

The Working Groups set up for the study of Productivity Measurement commenced activities on 21st May. Sixty members make up the groups which operate under the guidance of Mr. N. A. Dudley, M.I.Prod.E. Valuable data and experience are being accumulated, and it is hoped that a very informative report will result from this initial venture.

The Section's Spring Dance was held on 4th May at the Star and Garter Hotel, Wolverhampton, when 140 dancers enjoyed a pleasant evening.

INSTITUTION OF PRODUCTION ENGINEERS

CONFERENCE

HARROGATE

28th JUNE - 1st JULY

1951

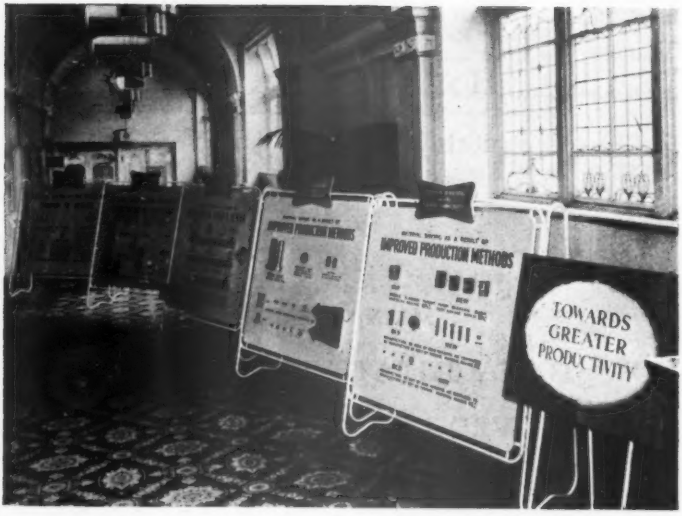
MAIN THEME :

HOW TO FACILITATE THE INTRODUCTION OF IMPROVED METHODS INTO INDUSTRY

SUB-THEMES :

(a) "How to apply, for the betterment of all, the techniques and procedures developed by the best British Factories."

(b) "How to implement the main recommendations in the Reports of the Teams of the Anglo-American Council on Productivity."



Part of the exhibition, held concurrently with the Conference, showing how scarce materials can be effectively used.

DISCUSSION GROUP "A"

HOW CAN PRODUCTION ENGINEERING METHODS ENSURE THE MOST EFFECTIVE USE OF MATERIALS?

by J. R. WIDDOWSON, A.M.I.Prod.E., Chief Development Engineer, Samuel Fox & Co. Ltd., Sheffield.

Chairman: L. R. EVANS, M.I.Mech.E., M.I.Prod.E.
Group Reporter: E. W. HANCOCK, M.B.E., M.I.Prod.E.
Rapporteur: E. LEVESLEY, M.I.Prod.E.

THE subject of this paper is a very wide one, and it will be appreciated that any one item of material in short supply could only be dealt with adequately in a paper of much greater length than the time available at this Conference permits.

Since this paper is being presented from Sheffield, it is natural that those materials which are the most important shortages for the Sheffield industries should be the subject.

Alloy steels including stainless steel, tool steel, etc., are of first importance to all Production Engineers; it is, therefore, appropriate that the time available today should be devoted to these items.

All Production Engineers will, of course, be aware of the short supply of alloy steel, stainless steel and tool steel, and since sulphuric acid and fuel play such an important part in the production of these steels it is necessary to include them in our consideration.

Obviously the first step must be to ensure that any of these materials are only used when absolutely essential, after careful thought and investigation of alternative materials and methods. This can only be achieved, of course, by the combined effort of the steelmaker, designers and Production Engineers, who must be prepared to explore and experiment with new techniques in both materials and methods of processing.

CONSERVATION OF ALLOYS

Much work has already been done in the field of alternative steels to replace the more highly alloyed steels, but it will be appreciated that the steelmaker can only go so far, the co-operation of Production Engineers is essential if maximum economy is to be achieved in the usage of alloys, such as nickel, molybdenum, cobalt, and tungsten, all of which are in very serious short supply at the present time.

Perhaps the first step in considering the design of any component should be to ensure that an alloy steel is not used when a carbon

steel will give the properties required, and secondly that where an alloy steel is essential efforts should be made to use the lowest percentage of alloy in the steel and yet meet the required service.

A very large range of steels with varying alloy content is available. The steelmaker is always ready to make proposals, and it is for the Production Engineer to co-operate with the steelmaker, and carry out tests with the alternative steels if the maximum economy is to be achieved.

Substitute steels, although having similar mechanical properties to the original steels do, in some instances, require a different technique in subsequent processing, where the co-operation of Production Engineers is vital.

Much work has already been done in this direction, examples of which are first the popular 18/8 and 12/12 Chrome Nickel steels, the former being used for general purposes where there is no deep drawing or pressing, and the latter for deep drawing and pressing.

The first move in the conservation of nickel was to substitute the 18/8 Cr-Ni steel for the 12/12 Cr-Ni steel, thus saving 4% of nickel, and this was achieved with the assistance of the fabricators who modified their methods of production and/or design of fabrication.

The next move was to consider the substitution of a steel entirely free from nickel, for these Cr-Ni steels and the steels for consideration are those with 13%, 17% and 20% Cr. respectively with carbon contents up to ·12%.

The 13% Cr. stainless steel has a slightly inferior corrosion resistance to the 18/8 and 12/12 Cr-Ni steels, but it is similar to that of the standard cutlery steel which incidentally is also 13% Cr. but has a higher carbon content of ·30%, and it may be used for domestic articles and indoor decorative work.

The 17% Cr. stainless steel has a corrosion resistance under atmospheric conditions similar to, or perhaps even slightly better than, that of the 12/12 Cr-Ni deep drawing stainless steel, whilst the 20% Cr. steel is even better and has a resistance of the same order as an 18/18 Cr-Ni steel.

It will very readily be seen that there are many applications for which one of these straight chromium stainless steels can quite satisfactorily be used in place of the chromium nickel steels which have been used in the past. Applications which come readily to mind are spoons and forks, hollow-ware, kitchen and canteen equipment, sinks and drainers, bar and shop fittings, car trim, bus fittings such as tubular rails and furnishings, etc.

It is therefore considered that the experience gained in connection with the conservation of nickel in manufacture of many of the stainless steels will be of lasting benefit.

SHORTAGE OF MOLYBDENUM

In the case of the molybdenum shortage, it is now necessary to find substitutes both for the manganese molybdenum direct hardening steels and for the nickel molybdenum case hardening qualities. Methods of achieving this have not as yet been fully worked out. A 1% chromium steel of the oil or water hardened type is a possibility for certain of the direct hardening applications, while for others low nickel chromium steels, where the alloy content can be obtained mainly from the scrap melted, will come in for consideration.

The mention of scrap brings to mind one of the most, if not the most, important contributions which all Production Engineers can make to our problem, i.e., the separation and conservation of all so-called scrap. In these days of shortages, scrap is certainly a misnomer; it is, in fact, a valuable raw material provided the strictest precautions are taken in regard to conserving the various qualities separately. In some cases such material can represent 100% of new steel. Theoretically all material used by Production Engineers, with the exception of a little rust and scale, can be eventually recovered, in which case there would be no new materials required. It is therefore to be hoped that Production Engineers will pay much more attention to this subject than has been done in the past, and it is suggested that if this problem was more understood throughout all grades of Production Engineering, from operatives to senior officials, a very important contribution could be made towards overcoming the shortages of such raw materials.

For the case hardening steels, there are prospects of low nickel chromium qualities free from molybdenum proving satisfactory for core strength of 45 tons per sq. in. minimum and 55 tons per sq. in. maximum. This suggestion is again based on the assumption that the bulk of the alloy content can be picked up from the scrap. Since much of this type of steel finds its way into gears for use in the transmission systems of internal combustion engines, the possibility must always be borne in mind of substituting direct hardening steels, perhaps with a light casing, which are known to be capable of giving excellent service while demanding smaller quantities of virgin alloy.

HIGH SPEED STEELS

In the case of high speed steels, substitute molybdenum qualities were extensively used during World War II in place of the 18% and 14% tungsten types. The shortage of molybdenum in the present emergency precludes such alternative materials and to make matters more difficult, vanadium is in limited supply, so that not more than 2% may be present and cobalt must be limited, since this metal will be required for more essential requirements of jet engine components.

It is clear, therefore, that if considerable savings of tungsten are to be effected, then one of the following two methods must be employed :—

1. A wider use of tipped tools.
2. The use of alternative steels in those cases especially where extreme hot hardness is not a prime factor.

So far as regards the first of these methods, there has been in the past a considerable use of tipped tools for plane turning operations and these should be extended as much as possible. Since only a small portion of any tool, be it drill, saw, milling cutter, etc., need be of high speed steel, it follows that a considerable saving of special steel could be achieved if methods could be worked out for making these tools with only the portion near the cutting edge of this material. The bulk of high speed steel in use goes into the manufacture of drills, and attention should be paid to methods of production of drills in which only the cutting edges are of high speed steel, the remainder being plain carbon steel.

Where extreme hot hardness is not required, a reduction in tungsten content to say about 11% or 12%, assisted by increase of vanadium up to the limit of 2% and an increase of carbon to take account of the increased vanadium, may be expected to give a reasonable performance, and such a steel is being tried out to ascertain how far it could be used in place of the standard 18/4/1 high speed steel. We already know that a 14% tungsten high speed steel with a slightly higher vanadium content than normal gives satisfactory results for saws in place of 18/4/1. Where such lower tungsten steels fall short in hot-hardness properties, then consideration would have to be given to whether an inferior steel could or could not be tolerated. Thus, an immediate saving by the use of a steel with a lower tungsten content might be more offset by the shorter life of the tool. Easing the conditions of machining would help to increase the life of the tool, but this must be weighed against the speed and cost of production. There is, however, a possibility that the Production Engineer could help in this direction.

There are some tools which do not require high hot-hardness properties, e.g., broaches and reamers. In such cases, steels with much lower alloy content could be used without serious reduction in performance. Thus the 4% tungsten reamer steel is being tested for performance against standard high speed steel, and there is no doubt that for many materials it will show a good account of itself.

SULPHURIC ACID

Sulphuric acid plays an important part in the processing of many types of steel, particularly alloy and stainless steel, its main use being as a means of removing scale from billets, bars, sheets, strip and wire. It is the cheapest of the acids available for this purpose, and the most largely used. The common practice is

to make up a batch of about one part of acid to nine of water, and heat to about 55° C. with an open steam pipe. The bath is then used until a stage is reached when it contains about 4% of acid in addition to some 15% ferrous sulphate, when the speed of pickling is reduced as the free acid content diminishes and the increased concentration of ferrous sulphate in the bath also has a retarding, or inhibiting, effect. This can to some extent be overcome by further additions of free acid, but eventually a stage is reached when so much ferrous sulphate is present that the increased amount of acid is ineffective. The liquid is then discharged and must be neutralised with Milk of Lime before passing to a sewer.

Here we have a clear example of valuable material wastage, in that unconsumed acid is lost, ferrous sulphate is not recovered, and another scarce commodity, hydrated lime, is used to render the other two harmless. By providing a simple acid recovery system, the sulphate laden acid is removed from the pickling tank and cooled down to 10° to 20° C., when quite half of the ferrous sulphate crystallises out and the acid, now somewhat stronger because crystallisation has removed some of the water, can be returned, with diminished iron content, for further pickling. Fresh acid can be added when necessary to counter the iron build-up until the stage is reached when a further cooling is required.

In a simple acid recovery system of this type no acid need ever be wasted provided that the pickling tanks do not leak and the amount of liquor circulating in the system is not allowed to exceed its capacity. This is very likely to happen if wet steam is supplied through an open pipe. By means of a closed steam coil, dilution effects are eliminated and water can be added at will to maintain the volume of liquor. By this method no acid is wasted, no lime is required, and the ferrous sulphate, or " green copperas," can be disposed of to the chemical industry, where it is used for a variety of purposes and will no doubt be in greater demand as sulphates of other metals become scarcer.

Annual material savings resulting at one works where acid recovery is practised on a billet pickling plant handling 34,000 tons of billets amounted to 152 tons of sulphuric acid (B.O.V. of 77% strength) and 100 tons of hydrated lime. In addition, over 500 tons of green copperas were recovered and sold to a chemical manufacturer.

These figures provide ample evidence of the wasteful nature of the procedure once accepted as normal, and offer encouragement in facing the years of stringent economy which lie ahead.

Where the products are of such a form that they can be fed continuously through a series of rolls, then a system of scale breaking

prior to pickling may be used. Here the material is bent backwards and forwards in order to break off the hot mill scale, which results in a larger output per ton of acid used.

It has been proved recently that by giving this material a second pass through the mechanical scale breaking machine, a much greater saving in acid has been achieved.

(Another method employed for this purpose, and no doubt capable of extension, is mechanical shot blasting for removal of scale, even if a final acid dip is necessary to complete the process satisfactorily. Molten salts, such as sodium hydride, which is a reducing process, and caustic soda plus potassium nitrate, which is an oxidising process, are now being used successfully in many directions, and again there is little doubt that these processes are capable of further extension resulting in important economies in the use of sulphuric acid, improvement in quality of the product, and in many cases at a reduced cost.)

CONSERVATION OF FUEL

Much has been said and written, and probably more publicity has been given to this subject, than any other. It can be said broadly that the essence of conservation of fuel is in its efficient use. To this end, most of the large firms employ fuel engineers in order to keep a strict control on the use of all types of fuel to ensure that no wastage occurs, and to suggest the best means for its efficient utilisation so that every unit of plant is used at its optimum capacity with the minimum amount of fuel.

Most of the smaller firms, however, do not follow this procedure, and in these cases the responsibility for saving fuel rests mainly with the supervisory staff. (In such cases it is suggested that one member of the staff should be given the opportunity of special instruction in the subject of fuel conservation. There are many opportunities for such instruction amongst existing fuel engineers employed by the larger Companies, or in consultation with the officials of the Ministry of Fuel and Power, who are always ready to assist wherever a fuel problem exists). Every opportunity should be taken when management and workers meet to arouse the interest of everyone in this subject.

No plant, however small, need be inefficient. Small wastages rapidly grow into large losses. Often the main plant is efficient, whilst fuel is wasted on small " home-made " units, inefficient space heating and other similar wastes.

It is suggested therefore that the following will be of assistance in helping to conserve fuel :—

Managers and Supervisory Staff

1. Ensure that every unit is utilised to the maximum, with the minimum number of units in use.

2. Ensure that the operators are correctly trained and always have in mind the need for the efficient use of fuel.
3. Watch that their plant is efficiently maintained.

Operators

1. Should be trained in the correct methods of the control of fuel using equipment and appreciate how fuel can be wasted.
2. Should report to their supervisory staff all cases of loss of fuel due to any cause, which is not within their own power to put right.
3. All other personnel not directly concerned with the control of the main fuel using equipment should work with the thought of fuel conservation in mind, as most people can influence the consumption of fuel in some way.

Engineers

1. The plant initially should be efficient for the work it has to do.
2. Having obtained an efficient plant, it should be properly maintained.
3. Mechanisation should be used to the full, as this maintains a higher standard of efficiency.
4. Instrumentation should be included in so far as this can be of use.
5. Small inefficient units should not be permitted.

It is not possible to elaborate in detail on all these items, as their application will vary considerably between works and trades. A few general points of detail may, however, be enumerated.

(*a*) The starting or heating up period of any plant should be as short as possible.
(*b*) Careful arrangements of the programming of work should be made.
(*c*) Furnaces and boilers should be adequately sealed during standing periods.
(*d*) Weekly consumption records should be kept of all fuel consuming units.
(*e*) Trials and tests of all equipment should be made periodically by the appropriate technical staff. If such staff is not available on the works, then use should be made of some outside technical service, such as the Ministry of Fuel and Power, who will make any tests necessary and analyse the results.

The programme for fuel conservation must be dealt with under short and long term policies. In the short term policy should be included the immediate correction of obvious wastages, careful programming, improvement of plant immediately possible, keeping of records and plant testing. Under the long term policy comes the installation of efficient plant, modification of plant which cannot be

done during short repairs, and the installation of instruments. In addition, heat can be recovered from gases by recuperators or waste heat boilers, also from steam condensate, provided that there is a use for the recovered heat.

It is only by the collective efforts of management, engineers and operators that the maximum saving of this vital and scarce commodity can be made.

Thanks are due to Messrs. Samuel Fox and Messrs. Firth Brown for the data contained in this paper.

DISCUSSION

Mr. B. C. HARRISON (Coventry) said that production of scrap should be reduced to a minimum by using processes which formed materials as near as possible to finished sizes, e.g. die-casting and pressing. Reclamation of scrap should be carried further than was usual, e.g. recovery of high speed steel from swarf from thread grinding of taps etc.

Cutting oil sludge, too bad for reclamation was now being used as fuel for heating shops and so on—this was inefficient as fuel, but was useful.

Mr. G. HANBY (Western) contended that technical control of all materials could be extended to save excess stocking. Actual usage should be measured and checked against budget requirements.

Mr. A. G. CLARK (Derby) advocated a closer co-ordination of Designer, Production Engineer, Buyer and Material Supplier. A change of mind was necessary in high places.

Mr. W. G. MARSDEN (London) said that small quantity production was often responsible for wastage, materials being ordered to cover several variations in a given model.

Mr. J. T. W. DEWAR (Sheffield) said that, from the suppliers' point of view, information and advice were readily given by the Research Departments of all large firms. Those in control should insist that designers ask for advice. As a result of one investigation, the steel for a set of furnace rollers was reduced from 40 per cent nickel to 8 per cent in most cases, and to 12 per cent nickel for all but one of the remainder.

As an example of long term policy for fuel saving, new equipment had been installed for space heating in the factory and what had been waste heat was now being used. This equipment would save its initial cost in a few years' time.

Mr. J. L. MEASE (Sheffield), agreeing with previous speakers about stock control, suggested that panic buying was responsible for many shortages at the moment. Scrap should be charted as the difference between weight received and finished weight.

Mr. A. J. AIERS (Wolverhampton) remarked that sulphur was being thrown away at many mines in the country and asked if this could be conserved in view of the shortage.

Mr. S. R. HOWES (Sheffield) emphasised that there was a real shortage of alloys for steel making and as special steels were necessary in the production of most other materials, it was vital that all users of steel should separate their scrap into types of alloy.

Mr. D. DUDFIELD (Wolverhampton) said that the tool designer could also play a part in material saving, particularly on press work, by arranging strip size and usage.

Mr. F. WOODIFIELD (Sheffield) emphasised the separation of carbon and alloy steel scrap, and suggested that all scrap should be bundled so as to save wagon space, and for easier handling.

Mr. W. H. HODGETTS (Birmingham) touched on the shortage of non-ferrous supplies, and asked for care in segregation of scrap. He asked if copper base alloys could be reclaimed by use of any acid process.

Mr. R. T. POSTLETHWAITE (Sheffield) suggested that the copper could probably be plated out.

Mr. C. B. TUPHOLME (Sheffield) answering a previous question, stated that it might be many years before a method of producing titanium was available.

The use of straight chromium steels instead of chrome nickel showed a saving in machining hours and tool steel.

Mr. P. HOLMES (Sheffield) asked if saving could be achieved by reduction in the number of " gadgets " in cars.

Mr. E. BARRS (Nottingham) replied that overseas customers demanded both " gadgets " and good finish—it would be disastrous to reduce quality.

Mr. D. G. BROWN (Manchester) said that standards of finish were required in order to reduce stocks of finishing products, grinding wheels, etc.

Mr. J. R. BERGNE-COUPLAND (Lincoln) thought that it was essential for managers and operatives to be trained in this matter of conservation, and that there should be interchange of departmental personnel in order to inculcate understanding of the necessity and possibilities of saving materials.

Mr. T. F. GILES (London) stated that in his experience some Government department designers were not interested in saving materials. He had met with little co-operation in this direction.

Mr. F. WOODIFIELD (Sheffield) suggested that arrangements might be made to improve supply of coal by working the full 168 hours per week as in the U.S.A.

Mr. A. J. AIERS (Wolverhampton) drew attention to the fact that synthetic gems could be used to replace high speed steel in some circumstances, but a new technique was required.

Mr. J. R. WIDDOWSON (Sheffield) spoke of the shortage of designers, and suggested that problems involved in conservation of materials should be taken up by the technical colleges.

Mr. J. H. GOLD (Sheffield) stated that steels with lower alloy content were not "ersatz," but developments. The use of these steels must be selective and were in no way detrimental to the user. They might require different technique in manipulation, and advice on this was available in research establishments.

Mr. E. W. HANCOCK (Coventry), summing up, said that the discussion showed how the subjects of the Groups were integral parts of a whole. The question arose: "Do the American industries who deal with the raw materials down to the finished stamping or pressing do the job better than the general British practice of separating the industries—steel-making, rolling, stamping, and so on."

A modern sign of inefficiency was the heavy removal of scrap by machining. Ultimately, scrap was only allowable when the article was worn out. Scientific Management, with its collection of facts and control of stocks, was the main way of conservation.

Co-operation at all levels in the organisation was essential, and should begin at the start of any project. Horizontal contacts through staff were most necessary and very difficult to obtain.

The subject should be *Costs* and *not Price*.

One material not mentioned previously was water. In this country drought and flood were experienced almost side by side, and conservation was necessary.

DISCUSSION GROUP "B"

THE IMPORTANCE OF MATERIALS HANDLING METHODS, INCLUDING EXTERNAL TRANSPORTATION

by W. M. HIORNS, A.M.I.Prod.E., Chief Materials Handling Engineer, Humber Ltd.

Chairman: B. C. HARRISON, M.I.Prod.E.
Group Reporter: E. W. HANCOCK, M.B.E., M.I.Prod.E.
Rapporteur: C. J. SWAIN, M.I.Prod.E.

A REMARK passed by a visitor to an automobile assembly plant to the effect that he thought that "this materials handling business was being overdone" made me wonder if there are many more people in industry who are thinking that way. Are we tending to overstress the materials handling function in our planning? Is it just a phase that we are going through, or have we to develop it more and more as one of the aids to production, rather than something which has to be done by the lowest paid labour that can be found to take on the job?

My own personal view is, that the average Production Engineer and Shop Foreman are not aware of the importance of materials handling and that more definite information should be given to them stressing the relative costs of materials handling as against the costs of processing, machining and assembly.

There is really nothing very new in the ideas put forward in recent years on this subject, but whereas for many years careful study has been given to each and every motion of the machine operation, the welder and the assembler, the study of materials handling has been allowed to obtrude itself only when it could not be avoided.

In quite a number of factories, the methods of conveying goods have received a close study when the conveying has been combined with a process, and many ingenious mechanisms have been devised to cater for particular problems. The study of the whole of the movement of a particular part, from the time it is received to the point of inclusion in the assembly and the subsequent packing and despatch of the assembled product, has not until quite recently been undertaken; thus no one person has been in the position of being able to appreciate all the moves the part makes, all the distance it travels, and moreover, how much unnecessary cost is added to the final product under that convenient heading of

" OVERHEADS." It is only by a systematic study of all the movements made by particular components that an appreciation can be made of the cost savings obtained by efficient materials handling methods.

COST OF HANDLING MATERIALS

The cost of handling materials is but one of the many things that a study of material movement will bring to light. The inadequacy of the materials handling equipment may in some cases be determined ; the inefficiency of method may be revealed, the bottleneck in the production operation is certain to be found, and the reasons for damaged material and unsafe practices cannot fail to be brought to light as a result of this detailed study.

One of the recommendations of the Materials Handling Productivity Team was that individual managements should conduct an investigation into their materials handling costs as a basis for the calculation of savings resulting from the application of new and improved methods. This to be done by classifying and extracting materials handling costs for

(*a*) Goods inwards and raw materials storage.

(*b*) Handling and storing materials through process and assembly departments.

(*c*) Handling and storing the materials in packing departments, Finished Stores and Despatch.

Close studies should be made and the resultant savings clearly shown, thus providing evidence to induce further action. How many firms have, I wonder, acted on that recommendation and what are the results? Perhaps in the discussion someone may have some pertinent points to make on that aspect.

INADEQUATE USE OF SPACE

The close study of materials handling in almost every factory where it has been applied has nearly always shown the inadequate use of space. The use of " air rights " as the Americans say, has been sadly neglected, but with the developments in stacking appliances in conjunction with the application of pallet methods, there has been opened up the third dimension wherever we want to use it. This technique, which is as yet comparatively undeveloped in Britain, is the biggest advance in modern materials handling, and will lead to very important developments in industrial handling and transportation. For now, instead of thinking of the movement of material within our factory premises, we have to enlarge our vision to take in all the movement from our supplier of material to receiving, storing, machine shop, processing, assembly and despatch, right through

to the customer's doorstep, which is a totally different conception, and a problem requiring a special approach to that which we had previously thought of as materials handling.

This special approach has to be such that a visual chart indication can be made of every movement, and the resultant line straightened and shortened to the limit ; then, and only then, is the moment to work out your new materials handling method and technique. The visual flow chart method is the guide to the Materials Handling Engineer, and not a text book. It will show him where plant layout needs revising, where operations need re-grouping, where process can be combined with transportation, and how far short all the conditions are from the ideal.

The Materials Handling Engineer will need to look beyond the Receiving Deck of his goods inward section and see the fashion in which the suppliers of materials are dealing with their problems of loading and method of transportation of goods. How are the suppliers sending in their goods ?

It is amazing in this so-called mechanical age that we engineers have neglected the problems of efficient utilisation of vehicle capacity and the speedy turn round of vehicles at loading and unloading decks. Every day we can see vehicles loaded in the same manner as 50 years ago. Forgings and castings heaped on the floor of the vehicle, nuts, bolts, pressings and the like in sacks, larger pressings stacked in covered lorries, all these requiring to be man-handled from vehicle to unloading deck. What a colossal waste of man's energy, of time and therefore of money, is this back-breaking piece by piece handling of goods ! We are justifiably proud when we produce a machine which will cut the machining time of a job by 50%, but by how much could we cut this muscle money if we used the mechanical equipment and its ancillary devices which are available by investing only the cost of the machine of which we are so proud !

An instance was given to me within the last six months where 4 men were needed to unload pressings from a vehicle, the time taken 45 minutes equalling 3 man-hours. One man could have unloaded the same amount suitably contained or palletised in 15 minutes, a saving of two and three-quarter man-hours. The vehicle was loaded in this manner, not only because the supplying firm had not realised the value of the introduction of modern materials handling methods as applied to loading and transportation, but also because a re-layout of despatch facilities would be necessary, and that they felt could not be undertaken due to economic necessity.

It is very true that a goodly proportion of our factories are very inadequately equipped for receiving and despatch of materials, in respect of suitable buildings and of handling equipment. But this being so, it should not be the excuse for just doing nothing about it.

There is modern equipment which can be used in confined spaces and which will considerably reduce the time and effort required to load or unload vehicles.

In the interest of both labour and management, it behoves the responsible authorities to promote investigation into these problems and to secure the maximum benefit from the use of the equipment now available in this country.

ELIMINATION OF UNNECESSARY HANDLING

The elimination of all unnecessary handling of materials must, therefore, start with the supplier of your raw materials in the form of castings, forgings, bar, billet, sheet or any other type of materials. It is essential that these are packed, transported and handled in such a way that they can be unloaded, stored and transported to the first point of operation or process, without the necessity of handling piece by piece. In other words, the container or package in which they are despatched from the supplier is the one in which they are transported and deposited at the required point of operation in your manufacturing division. To achieve this ideal may require, in some cases, considerable negotiation between the firms involved, and a constant and effective liaison has to be instituted in order to maintain the procedure when it is established. These negotiations, in present day circumstances, may be of a very prolonged and delicate nature, but with tact and perseverance the results can usually be obtained, and the cost savings with attendant economies will be eventually realised. The problems of the selection and in some cases of the development of the most suitable container, package or unit load are many and varied.

Each industry has its own particular aspect, but basic principles can be laid down to cover them all. The unit load system can be applied to most of the lighter and medium class of industry, where loads of up to two tons can be packed or palletised as a unit load and handled by means of fork truck or pallet truck. The construction of the unit load must of necessity depend upon the type of goods, whether it is essential that protection from damage during transit is required, in which case specially designed packs are necessary, or whether the goods can be carried in a standard type of container designed for fork and pallet truck operations.

In either of these cases the dimensions of the container or unit load should have regard to vehicle capacity, and sizes of vehicle decks.

As the width of British vehicles is limited to 7 ft. 6 ins. by law and as most decks are fitted with raves or sides, the available stacking width is limited to approximately seven feet or less according to the make of vehicle. Thus it follows that to use effectually the whole of that width, the container, pallet or unit load should be

seven feet or a figure which when multiplied by 2 or more will be seven feet, so we arrive at one dimension of our pallet or container based on the width of the lorry deck. The second dimension is mainly based upon the type of goods to be carried, and the size of the articles, and may be up to six or seven feet if size and not weight is the ruling factor.

Due regard should be paid to the length of the lorry deck in determining the second dimension of the load, but as vehicles vary according to type, load carrying capacity, and construction, no definite standards can be set. The height of the container or unit load is determined by the size, quantity and weight of the articles to be carried, and also by the height to which the tiered loads can be economically stacked in storage areas.

The standardisation of vehicle deck sizes would appear to warrant serious consideration by vehicle designers, as even in one organisation a type of vehicle having a nominal width of seven feet three inches, the deck actually varies as much as five inches below that figure, with the result that pallet loads designed to use the full width become unsafe loads, hanging partly over the raves.

USE OF TRAILERS AND TRACTORS

The use of the trailer and tractor type of vehicle is very much favoured in the United States trucking industry, and has many advantages in operation as users of this type of equipment in Britain have realised. The development of the large covered trailer has not reached the same stage in Britain as it has in the States, where the forty feet long vehicle is a very familiar sight at the loading and unloading decks. May we just consider what equipment is necessary to load and unload the palletised goods; first, we must list the Fork Truck for conveying the goods to and from the deck, second, the Pallet Truck for short deck movement and placing the unit loads in position on the vehicle. The Fork Trucks are so well known by now that no description of what they can do is necessary; the pallet trucks may be either manually operated using human muscle for motive power, or they may be of the powered type and controlled by the simple hand grip, requiring the smallest effort to operate ; these two pieces of equipment together with the necessary deck and manoeuvring space are the only absolute essentials.

MANY ADVANTAGES

The technique is simple, the operation is safe and speedy, the saving in manpower may be up to 300 per cent., so why do we not *all* use it? There are snags, of course. The cost of containers, pallets, and specially designed post pallets may be anything from £1 to £20 each item. There is the problem of getting the empties back, and this is

indeed a headache for the stores and transport supervision. There is the maintenance in good condition of containers, pallets and equipment. Without this maintenance, the system would break up and the bad old methods creep back. There is prejudice in some quarters against new methods, particularly if a scheme proposes to eliminate labour. But in spite of these snags, which are there to be overcome, the system is well worth all the time and cost of establishing it.

The rewards of a good and efficiently operated materials handling system are to be found in the satisfaction of labour, having taken out all the back-breaking laborious manual handling, and the satisfaction of management, who have been able to put men on production jobs who formerly were non-producers, and thus increase productivity. It is also possible to reduce cost of handling by elimination of unnecessary moves, by making it possible to move bigger loads with less men, by making inventory of stocks a simple calculation, by ensuring a steady flow of material into and through the manufacturing departments obtaining many indirect savings, and an increase in production by elimination of waiting time on the part of production operators. Furthermore, it is a recognised fact that by the introduction of improved handling methods accident hazards are reduced and lost time through accidents cut by a considerable percentage, and what is very important in these days of restricted new building facilities, a better utilisation of storage areas by using the third dimension to the maximum capacity.

The co-ordination of the materials handling system within the factory, with the method of transportation of supplies and of product despatch, should be initiated and continually reviewed in all industry, for it is only by obtaining an overall picture that a comprehensive scheme of handling materials for industry can be devised for the benefit of all engaged in manufacture and distribution.

THE RIGHT APPROACH

The solution of materials handling problems is not an exact science, and many companies in the United States and indeed, some in Britain, employ full time engineers to plan and apply handling methods, helping workshop supervision to make the greatest use of the equipment provided. It is considered necessary to have a defined and organised approach to a problem which concerns so large a proportion of production costs.

May I put it to you, as Production Engineers, that the problem is worthy of your close attention in the interests of British industry and the present-day economy, insofar as it is bound up with the

effective utilisation of productive manpower and the elimination of unnecessary effort by the use of modern mechanical means of material movement.

DISCUSSION

Opening the discussion, Mr. J. HARRIS (Coventry), said it would be interesting to determine the actual number of hours used in actual material handling, in relation to the total number of hours on the manufactured product, to enable the attack to be made on that part of material handling which showed the greatest savings.

Mr. T. W. ELKINGTON (Birmingham) remarked that an endeavour should obviously be made when planning new jobs, to dispense with handling wherever possible. The use of gravity chutes, simple turn-tables and hoppers could greatly assist the flow of materials. Good mechanical handling would also reduce accidents. Considerable savings by material handling in press shops could be made by baling the scrap material on the spot.

Mr. N. ROBINSON (Manchester) thought that putting over the technique of materials handling was relatively easy inside one's own plant, but it was far more difficult to convince the outside supplier and obtain his co-operation. This particularly applied to the handling of materials by the docks.

Mr. H. P. SANDERSON (West Wales) supported the previous speaker's difficulties re handling of incoming materials from Canada, and getting the docks to appreciate the necessity of efficiently palletising these materials to avoid damage and speed up transportation.

Mr. N. ROBINSON (Manchester) further stated that arrangements had actually been made to pay more money to get these materials handled properly by the dock people.

Mr. W. M. HIORNS (Coventry) replying, stated that meetings had been held with the Port of London Authorities on the use of fork trucks in the docks, but a far more serious consideration was the full utilisation of British Transport Service lorries bringing loads to factories, and not taking away full loads. Concerning the savings by materials handling, Mr. Hiorns stated that it was difficult to eliminate the actual handling done by operators as part of their particular operation, but if these operations were studied, it was possible by simple equipment to eliminate placing work on the floor. The important point was to keep materials mobile. The main consideration should not be how to handle swarf and scrap, but how to revise production methods to eliminate these two factors altogether. Every effort should be made to get full co-operation of suppliers to deliver their materials in the containers, or on the pallets being used in the particular factory. He also stressed the urgent necessity of the standardisation of pallets and containers.

Mr. L. ROME (London) stated he was chief engineer of a group of tobacco factories in South Africa, and one of his major problems was the stacking of materials for considerable periods, involving the use of about 20,000 pallets. He found by investigation that a certain amount of this palletisation could be eliminated through loading the lorries by means of inclined conveyor belts. His method of dealing with swarf was to have swarf containers with perforated trays underneath individual machines.

Mr. D. F. H. RUSHTON (North Eastern) stated that his firm on soap production were introducing a paper pallet system. These paper pallets were handled by special fork trucks supplied from U.S.A. The cost of 10,000 paper pallets was approximately £2,500, compared with £30,000 for a similar quantity of wooden ones. The life of a paper pallet was approximately one-third that of a wooden pallet, and this obviously showed a very good saving in money. The main difficulty in this scheme was getting the licence to obtain the paper pallets.

Mr. L. HOLT (Wolverhampton) considered that careful study of the present methods of materials handling before installing any other mechanical means was very essential He quoted dipping of 15,000 parts per day in a protective solution and transporting these to a warehouse, Each part weighed approximately 4 ounces and the present method involved the use of two men. A conveyor was eventually installed which necessitated mechanical unloading, thereby eliminating one man. He considered that the fork truck for small factories was far more universal in its use than other means of mechanical handling, and that machine tool designers could help considerably with swarf problems.

Mr. J. R. BERGNE-COUPLAND (Lincoln) contended that small job production firms had far greater difficulties in material handling than the larger mass production concerns. He had installed a swarf removal method by placing a bin against each machine tool into which the swarf was placed by the operator, and the bin was removed periodically by means of the fork truck with the swivelling head, which in the case of cast iron would be emptied straight into the railway wagons.

Mr. MARTIN made a plea for the humble wheel-barrow. He said he had visited a small factory in the States which used wheel-barrows as pallets or containers at the side of production machines, thereby maintaining a high standard of mobility of the work for a very small cost. He considered that great use could be made of simple chutes and that gravity could be effectively used. He thought that an endeavour should be made to make the maximum possible use of present factories and plant, as new factories and

new plant under present-day conditions were difficult to obtain. Mass production factories could more easily instal conveyors and various materials handling aids than the small jobbing shops.

Mr. F. B. SCHOFIELD (Preston) said that it must be considered that industry was composed of many small factories, making a wide diversity of products. Many of these small factories had not room to operate fork trucks. Therefore other mechanical aids should be considered, and more information regarding the savings by various methods of materials handling should be made available, so as to encourage these small firms to tackle their problems on a sound basis.

Mr. H. P. SANDERSON (West Wales) felt that the Institution should contact the larger firms with a view to bringing pressure to bear on the authorities, regarding the maximum use of materials handling appliances in the docks and on the railways.

Mr. W. M. HIORNS (Coventry), in his final remarks, pointed out that fork trucks were not the only means employed in materials handling, but every firm should carefully study its own problems and consider the means and methods of improving the straight line flow of materials.

The humble wheel-barrow mentioned by a previous speaker seemed to present some difficulty in using "air rights"; 80 per cent of factories in the United States employed less than 500 people, but they were fully conscious of these handling problems and used all means of reducing their handling costs.

One particular three-storey factory which he had visited during his tour had no special appliances whatsoever, but made use of gravity chutes all over the factory. He emphasised the fact that the simple methods were very often the most efficient. Fork trucks could handle different components if the components were properly palletised.

Mr. E. W. HANCOCK (Coventry) summarised the discussion and made a strong plea for industry as a whole to study the materials handling problem and make a big endeavour to cut costs in this direction.

DISCUSSION GROUP 'C'

HOW TO CREATE GREATER PRODUCTIVITY BY SIMPLIFICATION OF DESIGN

by H. LISTER, A.M.I.Mech.E., A.M.I.E.E., A.M.I.Prod.E., Manager, Standards and Specification Section, English Electric Co. Ltd.

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ALTHOUGH the advantages of some standardisation have been recognised by the engineering industry for a long period, as can be appreciated by reading the B.S.I. Jubilee Report on " 50 Years of British Standards," and from the recent exhibition held at the Science Museum, it is only in recent years that consideration has been given to Simplification in parallel with Standardisation.

The necessity for this consideration was given considerable publicity by the issue of two reports in 1949, firstly, the " Lemon " Committee Report on " Standardisation of Engineering Products," and secondly, the Anglo-American Council Productivity Report " Simplification in Industry."

SCOPE OF SIMPLIFICATION

For this discussion we must first of all consider where simplification can assist us, and I would make the point here that wherever we can create simplification, increased productivity should automatically follow, if the advantages offered are accepted. Let us then list the salient details where a process of simplification can be applied :—

1. We must consider a simplification and standardisation of the range of our finished products.

2. We must consider a standardisation of detail components within a range of products and over a variety of ranges.

3. We must consider a simplification of component design to ensure that the design has been considered with due regard to the method of manufacture, as well as to its functional requirements, so that the component may be manufactured by the simplest method.

4. We have to consider the rationalisation of raw materials and the simplification of the size ranges required.

5. A reduction in the range of raw material sizes will enable greater standardisation of shop equipment and small tools, so enabling the design and Production Engineers to know what manufacturing equipment is immediately available.

6. It is just as essential to have standardisation of jig and fixture details as other components, so that so far as possible these parts can be manufactured in quantity by production methods and in themselves may be tooled.

7. We must have some measure of standardisation in the machine tools available for our production requirements.

8. We must consider the necessity for standardisation of the processes used in the manufacture of products, particularly with regard to such processes as heat treatment, surface preparation, finishing, etc.

9. In line with these points, it is essential to have standardisation and consequent simplification of the procedures used in the Drawing Offices and other Pre-Shop Departments.

I do not wish to claim that these details cover the whole range on which a process of simplification may be applied. I do feel they pinpoint sufficient to enable us to discuss this question of simplification, and that the discussion will bring out further details.

Neither do I wish to claim to have sufficient knowledge to discuss in detail all the above points or even the time to do so. I would, however, like to elaborate in some detail on one or two points and leave the discussion to elaborate on others.

METHODS OF PRODUCTION

Naturally our outlook and approach to this problem vary depending upon our activities.

If we are engaged on small quantity production or jobbing work, our concern on standardisation and simplification will be towards the consideration of standard manufacturing equipment and to ensure that component design will lend itself to manufacture with standard equipment, and not necessitate the installation of a wide range of equipment and special machine tools with a very low percentage utilisation.

Again, if we are engaged on batch production we still require to consider the simplification of component design to ensure the full utilisation of manufacturing equipment. In addition, we desire a standardisation of components wherever possible throughout a range of sizes and various ranges of products. This standardisation of components will then allow us to manufacture in economic quantities, so that it warrants the fullest consideration from a tooling point of view. Care must be exercised in the choice of raw materials for manufacturing the components to avoid excessive variety of stocks. We also require the standardisation of the machine tools, so that the jigs and fixtures will fit a range of machine tools without the use of adaptor plates, etc., and, so far as possible, will not be limited to a single machine. It is also of paramount importance to standardise the manufacturing processes of the type previously mentioned.

Finally, where we are engaged on mass production on line principles we are faced with different problems. Here we need not worry too much about design of details to suit standard manufacturing equipment, as we can often adopt single purpose machines more economically, but the design must be considered with due regard to the manufacturing methods to be used. Where possible, however, it is often preferable to purchase components from specialist manufacturers and a standard component will considerably assist to ensure a continuity of regular supply.

Similarly the use of raw materials to recognised standard specifications will help to ensure a continuity of regular supply, and will assist in obtaining a reduction in the variation of processes used for these materials.

Although it may be considered by some that all the above points are not the concern of the Production Engineer, I would say in every instance each one has a direct bearing on Productivity, and, therefore, demand consideration by the Production Engineer.

ADDITIONAL ADVANTAGES

Some other consequent advantages of a programme of simplification and standardisation as an aid to productivity may be summarised.

Employee training is considerably easier as the processes have been simplified and the diversity reduced.

Where a simplified range of products or components has been adopted, it tends to reduce seasonal operation as we can then manufacture components or products for stock without the risk of obsolescence.

The reduction in variety of both raw materials and finished components reduces idle capital, releases storeroom space and makes handling easier.

The simplification of drawing office procedure, together with the freezing of present designs for longer periods, allows for greater consideration of long term projects and forward thinking.

In addition, all the details so far mentioned have a direct bearing on manufacturing cost and in every instance will reduce this cost as a reduction of labour, material, overhead charges or a combination of all three, with the possible resultant demand for further increased production to meet increased sales.

DEFINITIONS

Whenever Simplification and Standardisation are discussed the argument arises as to whether these terms are synonymous or whether they are distinct. Personally I suggest the two terms are distinct but, as full benefit cannot be obtained by the use of either independently, it is usual to consider the process as

one. Also, it is argued, shall consideration be given firstly to Simplification and then to Standardisation, or *vice versa*? Again, I suggest that both processes should be simultaneous.

It is of interest, however, to consider a definition of each term, and the definitions recorded by the Division of Simplified Practice of the U.S. National Bureau of Standards are representative of recorded definitions.

Simplification. The process of Simplification is commercial and selective ; its function is to determine which sizes or items of a product are most important, and to concentrate production on them whenever possible. Simplification may be applied to articles already technically standardised as to design or size, or it may be applied as a step preliminary to technical standardisation, thereby clearing the way and reducing the number of items to be dealt with.

Standardisation, or as it is termed by the Division—Technical Standardisation, is creative ; its function is to determine and establish in use the best design, quality, method or process for performing a desired function.

AVAILABLE SPECIFICATIONS

Accepting these definitions it can be stated that the points I have previously mentioned fall mainly within the term Standardisation, and this depends upon the existence or establishment of standard specifications. Therefore, it is as well that we consider the sources of standard specifications.

Firstly, there are a number of international groups responsible for standardisation which, although independent in the past, are now becoming sections of the I.S.O., or International Organisation for Standardisation. Along with the international body should be mentioned the A.B.C. (American, British, Canadian) standards which, although primarily for service requirements, are having an increasing effect on industry.

Secondly, we have the various sets of national specifications which, within the particular country, are the most important. We in this country have the British Standards Institution responsible for organising our national standard specifications.

In addition to these bodies, most firms who work on a Simplification programme find it necessary to prepare Company Standards for internal use.

TYPES OF SPECIFICATIONS

The form that Standards may take can be divided into five main groups which, quoting Mr. Woodbridge of the B.S.I. can be classified as :—

1. *Standards of Fitness for Purpose and Performance.* Such standards would include those for the composition and physical properties of materials.

2. *Dimensional Standards.* Here the principal considerations are the rationalisation of sizes, and interchangeability.

3. *Standard Methods of Sampling and Testing*, such as standard tensile impact and hardness tests, tests on welded joints and acceptance tests for finished products.

4. *Standard Terms, Definitions and Symbols* enabling the use of a common language on drawings and specifications.

5. *Standard Codes of Practice* to ensure the correct application of standard articles and materials.

B.S.I. PROCEDURE

When considering British Standard Specifications we are often too apt to refer to the term " B.S.I. Spec." without giving a great deal of thought to its origin. With apologies to those here who are fully conversant with the methods of the B.S.I., it is as well to remind ourselves occasionally that a British Standard is prepared by a technical committee consisting of representatives of all sides of industry concerned, acting under the authority of an Industry Standards Committee.

The only B.S.I. staff member on each of these committees is the secretary who, in the case of the Technical Committee, need have no technical qualifications. It can, therefore, be appreciated that a Draft Standard is a compromise of the various views of the members of the Committee and, although in the majority of cases this system operates admirably, it does occasionally have drawbacks.

When we consider such specifications as B.S. 970, " Steels for General Purposes," we must agree that industry has saved considerable sums by this rationalisation and simplification of available steels.

I suggest that similar savings within industry could be made by the rationalisation of other older specifications. For instance, steel plate is covered by four or five different specifications with practically no difference in the qualities, but do tie the materials to particular products. I suggest that British industry today and in the foreseeable future cannot afford these luxuries such as B.S. 24 Section 6, parts 17 and 18, " Steel Plate for Railway Loco's. and Rolling Stock," respectively, and that a series of integrated grades is required.

Recently the B.S.I. circulated a draft document for the revision of a specification on the "Sizes of Silver Steel." This draft document listed as standard over 140 sizes up to $1\frac{1}{4}$" diameter. In four or five instances the size increment was 6/10ths and the instances were numerous of increments within $1\frac{1}{2}$ thousandths. Although this draft recommended a reduction of some 100 sizes from the original specification, I do not feel British industry requires these 140 sizes,

It will also be recalled that the Lemon Committee Report recommended that a demand for differing qualities should be met by a series of grades and not by averaging or striking the lowest common denominator.

It is with regard to such instances as those quoted, that a numerical strengthening of the B.S.I. staff would allow the time for investigations, and enable a stronger lead to be given to the Industry Standards and Technical Committees without materially affecting the system of voluntary agreement.

CASE DETAILS

Before concluding these remarks and handing the meeting back to the Chairman, let us consider the possibilities available by the application of simplification to some products.

If we examine carefully a particular range of products, we shall find considerable variations in both major and minor components which have arisen in the past, probably due to specific customer request. On further examination we shall generally find that 15% to 20% of the total number of variations account for 75% to 80% of the total production. The remaining 20% to 25% of total production is that part of production which requires the majority of variations.

By a careful consideration of design and by an energetic approach to the customer indicating the benefits he will derive in the form of reduced price, reduced delivery, easier maintenance due to increased availability of spares, etc., it is quite possible to reduce the variations to a figure approaching 10% of the original. This does not necessarily mean that a customer's choice is limited and variations impossible. If the design is carefully considered it will be possible to offer the customer variation in the assembled product, consisting of basic stock items assembled in the chassis, frame or case which has been designed to allow for particular alternative arrangements.

This reduction in numbers of the different components can only lead to increased productivity, as these component parts may be manufactured for stock in economic quantities. In addition the effect is not only limited to the shop floor but has equal effects in the so-called non-productive sections where, as mentioned previously, the work in the pre-shop departments decreases. In one particular instance which I may quote, the basic components of a product which had previously totalled over 100 variations is now reduced to 12 types, and all customers have supported the progress which has been made.

LARGE UNITS

I would also stress again that simplification is equally applicable to heavy engineering, which generally refers to the manufacture of single units. In this case, however, the stress must be laid on the smaller detail component

which often in the past has not received much consideration. Often all components have been re-drawn for each contract with very little co-ordination of other past and present contracts, such that similar components have varied in small detail and this variation has resulted in the necessity of new patterns, tools, etc., in each instance.

By careful control of drawing office procedure it is possible to reduce these variations to a limited range of sizes for each component which will cover all known requirements, and even if it is considered uneconomic to stock these ranges, production is assisted considerably as new patterns and tools are not required for each contract and D.O. time is saved.

Having prepared standardised detail components it is possible to have localised jigs and fixtures to assist in machining location faces, etc., of the main components. In addition, savings can be made on the main components by the application of other details of simplification already mentioned.

CONCLUSION

In the latter part of these brief notes I have tended to concentrate on production by batch methods, as I suggest the majority of British engineering uses these methods by which possibly the greatest advantages due to simplification can be attained.

I have not considered the methods of approach that can be made to apply a process of simplification, as this subject itself could be the title of a separate discussion group, but comments on this aspect may be brought out during the discussion.

DISCUSSION

Sir Norman Kipping (London) stated that the lecturer had fully sold his policy, and from his short description of the processes at his own Company, had shown how the responsibility for initiating instructions rested with the Design Office.

Mr. A. J. Aiers (Wolverhampton) complimented Mr. Lister on the grouping of standardisation and simplification in parallel, and whilst agreeing that the lecturer had been talking to " converts " to standardisation, there was no doubt that the discussion would be under the word " how."

It was essential that simplification and standardisation should be carried out without reduction in efficiency, and it must also be borne in mind that everything manufactured had to be sold, and sales effort must not be cut out. The question of rationalisation of raw materials was interesting as this connected up with the morning Session dealing with the most effective use of materials. Whilst agreeing with the standardisation of jig and fixture details, it was extremely difficult to get the Design side to co-operate.

The lecturer also mentioned standardisation in the machine tool world, but although this had been done effectively in England, firms were now experiencing great difficulty in this direction as all standardised machine tools were being exported. Where new machine tools were necessary it often meant accepting foreign tools of a new standard, and the costly job of re-equipping Tool Sections. The standardisation of heat treatment processes was an excellent proposition, but again with the various limiting supplies of steel it was difficult to put into practice.

Mr. D. DUDFIELD (Wolverhampton) emphasised the fact that it was up to the Production Engineer to get his viewpoint over to the Designer, so that the improvements put forward could become standard practice.

Mr. F. A. MARTIN (Sheffield) stated that the impression had been given that standardisation could only be used under " mass " production conditions, and he wanted to eliminate this fallacy. Firms who made special machine tools could, and often did, make a special point of standard components. Other firms who sold press tools found that fairly standardised die sets could be produced, and it was up to Production Engineers to press these points.

Mr. W. F. POTTER (Yorkshire) pointed the moral that standardisation could cause trouble, as, for instance, in the Unified Screw Thread. Here instead of eliminating stocks it would mean carrying extra stocks of tools, dies, taps and gauges. He instanced a point where one firm had standardised threads using a B.S.F., and due to reports from customers it was necessary to revert to Whitworth, as these were the only stocks available where their products were utilised.

Mr. H. LISTER drew attention to the point that, with the Unified Screw Thread, it would cause a difficulty and extra stocks in the opening stages, but 25 years hence we should be credited with foresight for having instituted such a worthy standard.

Mr. R. R. AYTON (Glasgow) could see difficulty in initiating a scheme of standardisation, and in the motor trade this must originate from the Design Office. His Company found it necessary for the Production Engineer to be brought into the proceedings early on, and to co-operate with the Design Office before drawings were issued to the shops.

Mr. J. L. MEASE (Sheffield) asked whether the maker or the user should decide on standardisation, and whether this did not leave it open for too many local standards. He also queried whether standardisation could not be a danger in holding back design of new products.

Mr. L. ROME (London) stated that as his firm received machine tools they created a stock of spare parts, and at the present time he now had stores carrying over 500 different types and sizes of

bearings. He looked forward to standardisation to help him in this difficulty. He also suggested that more use should be made of standard sizes and limits for bores. They had instituted this and it had been giving excellent results.

Mr. A. B. BROWN (Edinburgh) had again found great difficulty in pressing a change, although he was fully in favour of the points discussed at the meeting. He complimented the lecturer on his approach to the subject, and hoped that, now standardisation was in favour, at least they would standardise feet of electric motors.

Mr. F. JOHNSON (London) admitted that it was often necessary to be cunning to get standardisation effected. It must always be remembered that " the customer is always right " and it was the customers who would in the end " call the tune."

Mr. R. HUTCHESON (London) gave details of firms where standardisation was instituted, and certain designs were turned down due to the knurling not being to the Drawing Office standard. In actual practice it was found that there was one standard knurling tool in the shop to which all components were produced, and the Drawing Office standards were ignored. He also had experienced difficulty in heat treatment due to standardisation of processes.

Mr. R. BEASLEY (Wolverhampton) suggested that this country was a little backward in simplification of design, whereas in the U.S.A. the Project Engineer was always in attendance at Design meetings. It was the Project Engineer's job to see that all the points discussed at the meetings were fully covered.

Mr. B. E. STOKES (Birmingham) agreed that in the U.S.A. a Project Engineer was recognised, and extremely useful. He made a point that it should be essential that Designers should have a Production Engineering training ; this would eliminate many of the difficulties expressed at the meeting.

Mr. R. K. ALLAN (Luton), in reply to the query raised on ball and roller bearings, said that as they now had standardised sizes in metric, in the long run that would be a great help. In the meantime any firm requiring replacements would be fully covered.

Mr. W. G. MARSDEN (London) gave instances where the only way to institute standardisation was to force it from the suppliers by giving very long delivery for non-standard sizes, whereas standard sizes could be obtainable from stock. He found this worked excellently in practice. He also pointed out that standards should not limit designs. There was, and had been for many years, a standard brick, but it was agreed that the variation in the design of houses was enormous.

Mr. P. H. C. WADDINGTON (Coventry) confirmed the difficulty of working to standards of heat treatment, but suggested that this could be eliminated if trade names were ignored, and steels divided into their grades by chemical analysis.

Mr. E. W. HANCOCK (Coventry), in summing up the discussion, stated that it had brought out one or two interesting points—how the many separate meetings had found such common ground for discussion, and that the whole trend of the discussion was " how " to apply the suggestions and practice put forward. He thought the Designer should be given full scope. Standardisation must be made the servant of the Production Engineer.

DISCUSSION GROUP 'D'

HOW TO INTRODUCE AND APPLY METHODS OF TRAINING FOR THE ENGINEERING OF PRODUCTION

by F. H. PERKINS, B.Sc., M.I.Prod.E., Past Chairman, Education Committee, Chief Education Officer, I.C.I. Ltd.

Chairman: WILLIAM CORE, M.I.Prod.E.
Group Reporter: M. SEAMAN, M.Sc., M.I.Prod.E.
Rapporteur: R. HUTCHESON, A.M.I.Prod.E.

IT is proposed in this introduction to survey, very broadly, existing methods of training for the engineering of production, and then to pose the following questions for discussion :—

(*a*) What are the difficulties in the introduction and application of existing methods?

(*b*) If there are no serious difficulties, is the Conference reasonably satisfied with the present position?

Alternatively—

(*c*) If there are serious difficulties :

(i) Can any recommendations be made to overcome them ?

(ii) Can any recommendation be made in the development of the methods of training themselves that would facilitate their introduction and application ?

Before surveying existing facilities, it is necessary to define what is meant by " method of training for the engineering of production."

It is suggested that the subject should be confined to the training of those directly concerned with the planning and control of manufacturing activities. Broadly there are two categories of staff concerned :—

(1) The technical specialist—the Production Engineer, the Planning Engineer, etc.

(2) Those in direct production control—Works Manager, Production Manager, Superintendent and Foreman.

The relation of the production specialist, the Production Engineer, the Planning Engineer, to the production line of authority, will vary considerably in different companies. In some companies he will carry executive responsibility for production, and he will be required to possess management ability in addition to expert knowledge of methods of production planning and control. In other companies he may fill a functional rather than an executive position, and

although his work will still involve the achievement of results through his influence on others, he will be most concerned with the more technical aspect of production, planning and control.

For this particular category therefore, the content of any training programme, whatever form it may take, must include (*a*), specialist instruction in production technology, planning and control, and (*b*) studies of subjects which will aid the engineer in his management of men.

The training of category (2), although related, will vary from that of (1) in so far as emphasis must be placed on the development of knowledge and skill in the operation of existing processes combined with man management ability.

Those occupying supervisory positions in the production line of control require a knowledge of the techniques used by the specialist, in order that they may collaborate effectively in achieving the optimum production results.

METHODS OF TRAINING

It is suggested, however, that the discussion should be primarily concerned with the introduction and application of methods of training for category (1), although it may be wise not to exclude entirely consideration of the training of category (2) in so far as it is related to production planning and control.

In both categories it may also be desirable to differentiate between the training of—

(*a*) those in the process of qualifying ;

(*b*) those already established as qualified engineers, managers and supervisors.

Although there may be many variants, the two main forms of Production Engineering training are as follows :—

(1) Basic training as a professional engineer, either in the mechanical or electrical field, to which is added some sound practical production training and experience of at least two years' duration. The study of management subjects and the acquisition of knowledge and skill in production planning and control techniques are taken in the form of a " post graduate " course of study.

(2) Basic engineering training by means of part-time studies or sandwich courses, leading to professional qualifications, in which an elementary study of production subjects is embodied in the latter part of such courses, combined with five or six years of sound practical training.

An example of such a course would be the five-year part-time Engineering Course leading to the award of a Higher National Certificate in Production Engineering,

which this Institution was so largely instrumental in introducing in this country. More advanced studies, including those of production management and administration are normally pursued at a post certificate stage, and are subsequently endorsed on the Higher National Certificate.

Those following the first method of approach are dependent on the provision of post-graduate training facilities in local technical colleges or universities, and some of the subjects required at this stage are given below :—

Principles and Technology of Engineering Production.
Engineering Management and Industrial Relations.
Work Study (Method, Motion and Time Study, Incentives and Labour Control).
Production Planning and Control.
Statistical Methods.
Industrial Measurement.
Factory and Plant Layout.

At Birmingham University, in the Department of Principles of Engineering Production, under the leadership of Professor Matthew a one-year full-time course of instruction, embodying the above subjects in the curriculum is now available. So far, other Universities have not made any similar provision for post-graduate studies of this character. The College of Aeronautics at Cranfield has embodied a study of some of these subjects in the full-time course organised in the Department of Aircraft Economics and Production. Some of the development work, both in the subjects themselves and in the methods of teaching both at Birmingham and at Cranfield, is creating lively interest in industry generally, but the number of men in industry influenced by these opportunities is, so far, very small.

POST-GRADUATE COURSES

Another way in which the professional mechanical or electrical engineer can acquire his knowledge and skill in production techniques is to take post-graduate courses of study in local educational institutions. Short courses are organised from time to time by a number of Technical Colleges, and these courses provide an effective medium of adding to existing knowledge. Although many more Colleges could make provision for tuition of this character, if the demand was there, it is a fact that the number of engineers attending such courses is also very small, and the Summer Schools of the Institution of Production Engineers and the Ministry of Education, appear to be the only places where efforts are made to advance the teaching skill of those called upon to give instruction in these subjects.

By and large, teachers in these subjects must be drawn from industry, on a part-time basis, and excellent as many of these teachers are, it is open to debate whether sufficient is being done to advance the standard of teaching at post-graduate level, in the subjects under consideration.

The question is, therefore, " Are we satisfied with the present position in which the majority of production specialists who start initially as qualified engineers acquire much of their knowledge and skill in the 'school of hard practical experience' ? " If not, what can we do about it ? "

In regard to (2) let us consider, first of all, the broad basis of the curriculum and secondly, what has actually taken place in the development of this course, which is normally provided in the Technical Colleges, since its inception some ten years ago. The strength of this particular channel of approach lies in the substantial amount of practical experience that is acquired while studying.

All courses of this character include, in varying degrees, the following groups of subjects :—

A. *Basic* (General and Scientific).

English Language, Industrial and Social History, Mathematics, Physics and Chemistry.

B. *Scientific*—applied to engineering.

Strength of Materials, Theory of Machines, Applied Mechanics, Applied Electricity, Metallurgy, Engineering Drawing and Graphics.

C. *Technical*—specific to engineering processes.

Foundry processes, welding processes, forging, press work, sheet metal work, machine tools, jig and tool design, metrology, engineering plastics, plant layout and materials handling.

D. *Semi-Technical and Administrative*—applicable to all manufacture.

Work Study—process, method, motion, time, job evaluation, incentives and rate-fixing.

Planning and Control of Production, Quality Control, Industrial Organisation and Administration, Costing and Estimating.

Development and Research.

Economics.

By selective combination the above are reduced to form curricula of practical courses. The depth to which some of the subjects may be studied will depend upon the degree to which the basic sciences have been studied.

The above analysis is taken from the paper on " Studies in Production Engineering," written by the Institution's Education Officer and included in the special Educational Issue of the Journal in September, 1950.

It is interesting and significant to record that the number of Colleges offering such courses has increased from 26 to 41 during the last three or four years. It is doubtful, however, whether the increase in the actual number of students would convey the same idea of expansion. A list of these Colleges is given in Appendix I to this paper.

The table given in Appendix II indicates the growth of the numbers obtaining Higher National Certificates in Production Engineering, since the inception of the scheme. These figures may be compared with those for Higher National Certificates in Mechanical Engineering. The table also includes the number of candidates each year who have succeeded in obtaining endorsements on the Production Certificate.

It is also to be noted that some of these subjects may be endorsed on Higher National Certificates in Mechanical Engineering and these figures are not included in the above.

HIGHER NATIONAL CERTIFICATES

The small numbers of those obtaining Higher National Certificates in Production Engineering, in relation to Mechanical Engineering, namely 1 in 10, must be noted, although it must be borne in mind that the Higher National Certificate in Mechanical Engineering has been in existence for some 20 years longer than that in Production Engineering. The difference in time is not the whole story, and the fact has to be faced that the growth is disappointing and the following reasons for this are put forward for consideration :—

1. That the general influence of our Higher Institutions of Learning has been instrumental in directing an undue proportion of brains and ability of this country into the fields of public administration, engineering design and research rather than into the field of production itself.
2. That the prestige of a qualification in Production Engineering, in spite of all the emphasis of the last few years on the need for production efficiency, is still considered in educational and industrial circles as inferior to a recognised " mechanical or electrical qualification."
3. That industry itself has fallen short in its duty to foster in Technical Colleges and Universities the necessary research and development of study in Production Engineering subjects that would inevitably produce the quantity and quality of teachers required to enhance the prestige of these courses. Production Engineering subjects have only recently become more clearly defined and shown themselves capable of scientific analysis.
4. That the older professional Institutions themselves carry a large measure of responsibility for placing too much emphasis

on the merits of design, pure and applied research ability, to the detriment of parallel advance in the production field. The unremitting efforts of this Institution, although they have had a considerable influence, have still not succeeded in effecting an adequate balance of interest in these matters.

It is not anticipated that any measures we can advocate and introduce can quickly rectify a trend of many years, and the following questions therefore arise :—

(i) What are the obstacles in the way of a more general and rapid advance in the pursuit of courses such as those of the Higher National Certificate in Production Engineering ? Are these courses as far as they go, providing the type of basic training required for those directly concerned, or who are likely to be directly concerned in specialist production capacities ? If not, what changes are advocated ?

(ii) Are we in industry absorbing enough of the technical output of the Universities and directing their initial training towards positions of production responsibilities ?

(iii) Are we interpreting to the Universities and Colleges of the country the importance we attach to the development of men of technical and managerial capacity for specialist positions in the production field ?

It is for this Conference to give the country a lead in this matter and although a gradual evolution is taking place in the methods of training for Production Engineering, one thing remains absolutely certain, and that is that sound practical experience will always remain a vital and major factor, whatever the particular solution may be or whatever recommendations we may make.

Appendix I

COLLEGES OFFERING COURSES IN HIGHER NATIONAL CERTIFICATE IN PRODUCTION ENGINEERING

The 41 Colleges now offering courses of this character are as follows :—

Accrington Technical College.
Acton Technical College.
Birmingham College of Technology.
Bolton Municipal Technical College.
Bradford Technical College.
Brighton Municipal Technical College.
Bristol College of Technology.
Cheltenham, North Gloucestershire College.
Coventry Technical College.
Croydon Polytechnic.
Derby Technical College.
Enfield Technical College.
Gateshead Technical College.
London, Wandsworth Technical College.
Luton and S. Bedfordshire College for Further Education.
Manchester Municipal College of Technology.
Oxford Schools of Technology, Art and Commerce.
Preston House Institute.
The Royal Aircraft Establishment Technical College.
Rugby College of Technology and Arts.
Salford Royal Technical College.
Smethwick, Chance Technical College.

Gillingham, Medway Technical College.
Ipswich School of Technology.
Keighley Technical College.
Kingston-upon-Thames Technical College.
Leeds College of Technology.
Leicester College of Technology.
Lincoln Technical College.
London Borough Polytechnic.
London, Northampton Polytechnic.
London, S.E. London Technical College.
Southampton University College.
Stockport College for Further Education.
Stoke-on-Trent, N. Staffordshire Technical College.
Twickenham Technical College.
Wednesbury County Technical College.
Willesden Technical College.
Wolverhampton and Staffordshire Technical College.

Scotland :

Edinburgh, Heriot-Watt College.
Glasgow, West of Scotland Committee on Technology.

Appendix II

Numbers (approximate) obtaining Higher National Certificates and Endorsements.

List No. 1—Higher National Certificates

	Production Engineering.		*Mechanical Engineering.*	
Year.	*Entrants.*	*Passes.*	*Entrants.*	*Passes.*
1942	35	24	1,240	970
1943	54	43	1,830	1,450
1944	89	71	1,670	1,250
1945	167	143	2,170	1,650
1946	161	116	2,300	1,740
1947	213	146	2,270	1,600
1948	282	234	2,870	2,080
1949	301	238	3,300	2,300
1950	353	281	—	—

List No. 2—Endorsements.

	Production Engineering.		*Mechanical Engineering.*	
Year.	*Entrants.*	*Passes.*	*Entrants.*	*Passes.*
1942	—	—	—	—
1943	—	—	—	—
1944	5	5	960	830
1945	49	45	1,050	990
1946	82	75	1,370	1,250
1947	67	58	1,680	1,470
1948	92	70	1,630	1,450
1949	146	126	2,110	1,740
1950	132	110	—	—

DISCUSSION

Mr. E. P. EDWARDS (Birmingham) said there were serious defects in all branches of training, but the Institution was indicating the right way. Larger firms were giving good basic training but smaller firms had to face the difficulties of expense, inability to spare staff, and a die-hard attitude. Generally there was a shortage of good teachers, and present teachers would benefit by short returns to industry as refresher courses. Small firms could combine regionally.

Mr. J. E. BURNETT (London) considered that needs of smaller firms differed from those of large concerns and there was need for training on a national basis. University facilities needed improvement but this benefited mainly large firms. Small firms had greater need for practical experience not gained by university students. There was a lack of men able to take responsibility. The order of qualities needed by large firms was :—(1) Personality and leadership ; (2) scientific training ; (3) practical training, and for small firms :—(1) Personality and leadership ; (2) practical training ; (3) technical training. All National Certificate courses should have early studies in production processes and problems to link up practical and theoretical work.

Prof. M. E. MUNDEL (U.S.A.) said that colleges in U.S.A. were not in themselves responsible for their large output of production men—this had been forced on to them by industry's demands. In U.S.A. the incentive was greater for young men to study production subjects, as graduates entering industry received high salaries commensurate with the efforts that they had made. Industry co-operated by large donations to colleges who did their best to merit the donations. Industry also supplied data, etc., for training purposes. He posed the question "*Could the Institution promote scholarships for teachers ?*" and lamented the lack of publicity for British Production Engineers and their work. The entrenched academic interests of universities must not be underestimated.

Mr. M. SEAMAN (London) remarked that a high Production Engineering degree course could be instituted in British universities by combining Production Engineering, chemical engineering and management subjects and, after two years, specialisation in one engineering subject and management.

Mr. B. H. DYSON (London) in comparing numbers of students quoted by Mr. Perkins as taking H.N.C. courses in mechanical and electrical engineering with those taking the Production Engineering courses, said that the percentage annual increase in students was greater in Production Engineering than in the others, although numerically smaller. Jig and tool designers needed practical training as operators using tools and as toolmakers' making tools,

so that they fully appreciated points such as easy loading and unloading, swarf clearance, etc. At national as well as industrial level steps were needed to induce lads to enter Production Engineering, and for the importance of Production Engineering to be stressed at both levels ; publicity must be given to the work being done and the scope offered by all teaching institutions. Industry must raise its standard of expectancy and its scope of promotion and be less conservative. There was lack of shop floor experience, and every Production Engineer should have experience as a junior foreman.

Mr. H. S. HULL (London) thought that few university men wanted shop experience after graduating, but every one of them needed it before or after graduating.

Mr. H. G. MACFARLANE (Visitor from Manchester) said there was a lack of co-operation between industry and technical colleges, but Production Engineering needed the cream of the students.

Mr. A. P. OPPENHEIMER (Glasgow) remarked that sandwich courses solved the problem of the lack of practical experience in the university graduate. In teaching syllabuses processes of metal forming, e.g., forging, should be stressed equally with metal cutting.

Mr. R. KIRCHNER (London) said there was a need for craftsmanship born of indentured apprenticeship. Craft apprentices should be encouraged to take City and Guilds Courses and examinations which were more related to their needs than National Certificate Courses.

Mr. H. P. JOST (London) stated that a degree sometimes barred a Production Engineer from small firm employment as it indicated that its holder had taken the usual mechanical or electrical course. A university degree in Production Engineering would benefit small firms.

Mr. H. TEASDALE (Western) said that there was difficulty in "selling" the H.N.C. course in Production Engineering to his apprentices, but their admission to Jig and Tool Drawing Offices had altered this ; they now knew what Production Engineering was. Some pre-university practical training was desirable. An *Ordinary* National Certificate in Production Engineering was needed to increase response.

Mr. T. B. WORTH (Institution Education Officer) said there was a need for an increased demand for training, but shortage of teachers impeded work at all levels. Any degree course should be linked closely to shop floor training.

Engineering works should have apprenticeships in Production Engineering. In U.S.A. Production Engineering courses started in 1908, but not until 1942 here, which was 20 years after the start of the H.N.C. in mechanical engineering. This accounted for the U.K. lagging behind the U.S.A.

Mr. D. F. H. RUSHTON (North Eastern) thought that an analytical approach was needed, but analytical thinking was not fostered in technical colleges as it was by universities.

Prof. J. R. IMMER (Reading) contended that the production man should be able to analyse production problems. He must have the courage of his convictions and be well paid to give him status and confidence.

Mr. R. R. AYTON (Glasgow) was of the opinion that a specialist should not be trained as such, but needed good knowledge of all branches of engineering coupled with good general education and wide practical experience.

Mr. W. MOSEY (London) thought that the Institution policy of "widening the base" was not supported by the Institution examination syllabus, which catered only for engineers engaged in engineering and not for engineers and chemists, etc., who controlled production on process work.

Mr. L. HOLT (Wolverhampton) stated that Production Engineering started on the drawing board, and designers should be production minded. Therefore mechanical and electrical engineering H.N.C. courses should embody production subjects. This should be additional to the H.N.C. course in Production Engineering.

Mr. J. CHERRY (Coventry) said that at Cranfield College all design students must take production subjects in their first year, and two-weeks' courses on management were organised for trained engineers.

Mr. PERKINS remarked that training of Production Engineers should not be done in a watertight compartment and along narrow lines. Institution members should encourage management and colleges to ensure that qualified men have prestige. Instruction within industry was essential.

Mr. M. SEAMAN (London), in summing up, said that :—

(1) The Institution was the largest factor influencing education in Production Engineering.

(2) Industrialists should say what support they would give colleges in cash and facilities.

(3) There was a need for basic training covering production technology and shop floor work. Men with qualities of leadership should be taken out and given training in technologies. The period after technical college or university referred to by Mr. Perkins was one where a man's potentialities would be brought out.

(4) Smaller firms could get together on a regional basis.

(5) All-round training to a B.Sc. level in Production Engineering would be a good thing.

(6) Craftsmanship was most important, and the Institution endorsed a high standard of craftsmanship training.

(7) It was useless to spend vast sums of money on training unless the resultant remuneration and status were high.

As a final thought, should training be done on an industry by industry basis or should management be treated widely? The special colleges, e.g. as at Birmingham or Cranfield, for post-graduate work were useless unless supported by adequate earlier training facilities.

DISCUSSION GROUP 'E'

HOW TO MEASURE PRODUCTIVITY BY STATISTICAL METHODS

by Professor MARVIN E. MUNDEL, Professor of Industrial Engineering, Purdue University, Lafayette, Indiana.

Chairman: H. BURKE, M.I.Mech.E., M.I.Prod.E., F.I.I.A.
Group Reporter: M. SEAMAN, M.Sc., M.I.Prod.E.
Rapporteur: B. E. STOKES, Grad.I.Prod.E.

IT is to be hoped that this discussion does not degenerate into a discussion of the possible ambiguity of the two key words " statistics " and " productivity." Statistics appears in the dictionary as " the science which deals with the collection, classification and use of numerical facts or data, bearing on a subject or matter " ; productivity as the " ability to create value or to produce objects of value."

In short, it is suggested that this session might have been re-titled " Numerical Measures of Industrial Performance."

The importance of this subject should be obvious. The task of management is to make decisions. Decisions imply the possibility of alternative courses of action ; further, realistic decisions require—

(*a*) A knowledge of existing circumstances.
(*b*) A stated objective.
(*c*) An opportunity to measure continually the progress from existing circumstances towards the objective. This requires a numerical measure.

Perhaps a great deal of confusion has been created by the use of the term " productivity " in a generic sense, when typical practice usually requires the recognition of specific factors which must be individually dealt with.

The Production Handbook gives four essential components of measurements :—

" 1. Definition of characteristic or quality to be measured.
2. Selection of standard for comparison.
3. Determination of unit or units in which the measurement is to be made.
4. Creation of accurate means to compare characteristic (measured) with standard. "

In addition, it points out " the difficulty of satisfying these requirements in connection with much industrial operation . . . because of the presence of the problem of measuring human

performance by accurate means." It might have further added notes on the difficulty of making international comparisons, caused by the different relative values of various elements in the total economy.

Be that as it may, the Production Handbook goes on to give a total of 96 factors in performance area and units in which they may be measured. This is by no means a complete list and I do not believe that any useful purpose would be served by giving it here in detail. It should suffice to know that it is available and reference to it should be made.

A tabulation such as this will aid in providing two of the essentials of the requirements of a measurement for performance ; the other two may be met by comparison to previous performance or desired goals, and by adequate tabulating and reporting procedures.

ADVANTAGE TO MANAGEMENT

Adequate modern management demands such tools. However, in their use, one whole area of knowledge is often overlooked. All of the sub-factors entering into performance measurement are not always under the control of management. Certain variations in measures, such as absenteeism or labour effectiveness (standard hours of work done/actual hours worked), may be from inherent random causes which may either mask or be mistaken for a variation due to controllable causes. The typical approach of physical statistical quality control with control limits and charts may be applied often quite appropriately to aid in an intelligent use of such measures.

In summary, perhaps the most useful approach that could be made today would be for members present to tell of various numerical measures of industrial performance they have found most useful in assisting them to achieve desired goals. Such a description should enable others to evaluate the applicability of the suggestions to their own situations and thus aid in the transfer of ideas. Hence, I believe it would be most helpful to the whole group if, in describing these measures, the describers would be so good as to give :

1. The goal sought.
2. The characteristic measured.
3. The units in which it was measured.
4. The method of collecting, tabulating and reporting these data.
5. The use made of these data.

DISCUSSION

Mr. WHITE (Birmingham) was of the opinion that Birmingham was backward in utilising measures of productivity, and he hoped that the discussion would bring out many useful ideas.

Mr. B. E. STOKES (Birmingham), at the request of Professor Mundel, gave a brief outline of the system of "Vital Statistics" in use at Joseph Lucas Ltd., so-called because of their life and death significance in Company affairs. These statistics were presented on six charts, of which the first three dealt with factors immediately affecting Customer Satisfaction, that was Product Quality, Total Saleable Stock and Production against Programme. The remaining charts, which were concerned with Product Design, Productivity and Product Cost, provided an indication of the rate of increase of productivity and cost reduction which were necessary in order that the Company could retain its customers. He gave brief details of the form, compilation and use of each of the charts, and emphasised that the endeavour was to work towards a positive object rather than to work away from a known level to some better situation not stated.

Mr. H. H. NORCROSS (Birmingham) thought that much suspicion and difficulty arose from the misguided application of measures of productivity in an endeavour to compare situations which were not alike. In his experience difficulties arose even in comparing two apparently similar activities, because the tolerances within the form of measurement threw suspicion upon the comparison. He suggested that measures of productivity should be concerned principally with indicating trends, and that relatively crude measures were useful for this purpose.

Mr. HODGETTS (Birmingham) also emphasised the difficulty of making comparisons between Companies and felt that comparisons should be restricted to inter-company activities. He outlined some possible forms of measurement in which he had been concerned.

Mr. A. P. OPPENHEIMER (Glasgow) stressed the importance of some form of indication of progress at the lower levels of management, and suggested that a foreman should be provided with charts showing such things as the average percentage bonus earned by his operators, his departmental efficiency, scrap, etc. in relation to given standards. Such charts could also be used when explaining points to the operators.

Mr. M. SEAMAN (London) emphasised some of the dangers that were likely to arise in making international comparisons due to factors such as devaluation. He pointed out that any wide use of statistics demanded effectiveness at shop floor level and consequently must be simple; refer to a limited number of factors and require no high mathematical understanding. He further stressed the value of cost standards in the preparation of such statistics.

Mr. A. G. CLARK (Derby) explained a system with which he was familar, and stressed the importance of the measurement of trends within an activity as an instrument of managerial control.

Mr. R. W. MANN (N.E. Section) suggested that the problem of raising productivity within the small company could not be solved by the methods which had been explained by previous speakers. He considered that the profitability of a company was as good a measure of its productivity as any. He stressed the importance of simple forms of measurement and outlined some ideas which he had put into practice based upon the continuous analysis of factory cost.

Sir EWART SMITH (I.C.I. Ltd.) emphasised the necessity for management to have some overall form of measurement, preferably based on a datum year and indicating the rate of change. He pointed out, by quoting practical examples, that production statistics were relative.

Mr. C. R. JORDAN (Birmingham) suggested that a proper presentation of the financial accounts of a company provided a cheap and universal method of measurement. He suggested that the presentation of a profit and loss account and balance sheet every month, with adequate comparisons with previous achievements, provided a sufficient indication of the way the company was going.

Mr. F. W. TAYLOR (Visitor, Southern Section) stressed the importance of budgetary control and the use of statistics in forecasting future labour or job requirements. He thought that forward machine loading could also be used to advantage much more widely.

Mr. LYLE (Derby) again stressed the problems of the small company and felt that the balance sheet was not always a sufficient indication of the rate of improvement within the company. He thought that a comparison between the costs of like jobs undertaken at different times provided a good indication of the rate of improvement within the company.

Mr. D. DUDFIELD (Wolverhampton) stressed the importance of aiming for a maintenance of costs at existing levels despite the rise in prices of various materials, etc., and of mechanisation which could often be justified by working more hours per day.

In summing up, Professor MUNDEL pointed out that the primary purpose of numerical measures lay in their use as a guide to action when new problems arose. There was less difference of opinion between the various speakers than was readily apparent. All the plans and systems which had been outlined had the same characteristics and were, in fact, used as a guide for management decision.

DISCUSSION GROUP 'F'

HOW TO CHOOSE THE RIGHT INCENTIVE SCHEME

by R. W. MANN, M.I.Prod.E., M.I.Min.E., President, North-Eastern Section. Managing Director, Victor Products (Wallsend) Ltd.

Chairman: I. G. HOPKINSON, M.I.Prod.E.
Group Reporter: M. SEAMAN, M.Sc., M.I.Prod.E.

I HAVE been asked to talk on incentives to work people, and in the general acceptance of the term, know that the " producer " is indicated.

I would commence by expressing my strongly-held view that we lay far too much stress on the importance of incentives to labour, when thinking in terms of total output per man-hour. Any modern manufacturing business is a partnership of labour, management and capital, and I am of the firm opinion that all three parties need, and are equally entitled to, their share of incentive.

The problem is, therefore, that of increased total production from the same labour force. It is one of incentive. Not one in one hundred thousand human beings will work without incentive, but incentive takes many forms, and must apply equally to all three partners in industry. I am not at all sure in my own mind that the lack of incentive to capital and management is much more largely responsible for the existing deplorable economics of the present time, than the suggested failure of the producer to pull his weight.

Let me, therefore, remind you for the moment of the basic constitution of the engineering industry :

98·9% of all firms engaged in Engineering employ less than 500 employees.

85·4% of all employees are working with firms of less than 1,000 employees each.

Approximately only 10% of all firms are Public Limited Companies.

The broad analysis of this position is that engineering in this country is the business of the little man, employing his own or a limited private capital. From this point we are in a position to view the incentive needs of all three partners.

WHAT ARE THE PROFITS ?

If you let me suggest that in the above general sense capital means the owner, then what does the averag owner or part-owner need from industry ? Equally broadly the answer would be " Profit," but not by any means in the

narrow sense of more money to buy personal pleasures. True, a successful business man or owner expects to be able to live at a reasonably high standard, if only for the purpose of proving his success, but 99·9% of such a class has always the appreciation of profits for their ability to increase the size of the factory or its amenities. Indeed, the two things run together; there is rarely such a thing as a stable business, a firm either increases or decreases in importance, and the very effect of a profitable business is the need for continuous expansion.

In the days of our fathers, it was the basic growth of the national prosperity that business was capitalised out of profits. Today the situation is entirely different. If ever there was a time of our National Financial Policy which set out to kill the goose that lays the golden eggs, this is it. The 100% war-time excess profits tax completely ignored the need of healthy companies for expansion, and resulted in a majority of such firms being placed in the fantastic position of either having to borrow from the banks to pay profit taxation, stifle their expansion, or allow their machinery and processes to become obsolete.

The post-war position is equally bad, taking the case of an average engineering firm with a turnover of £100,000 and a gross profit of, say, £10,000 with a need for expansion of, say, only 10%. Assuming a working capital of £40,000 and a dividend of 6%, there is left for new machinery, buildings, increase in stock values, increase in Debtor's Account, a sum after taxation and dividend of approximately £3,000.

In other words, adequate expansion out of profits under present-day conditions is impossible, and the Private Limited Company is faced with the necessity of putting its business further into the hands of the banks, or alternatively floating a public company, with the inevitable loss of control of the existing owner or owners.

Here then is the first need of incentive, and in my mind the greatest need if industry is to fill the gap of our adverse trade balance. Admittedly today high taxation is a necessity to avoid inflation, but an incentive is available as part of a long term policy which has been pressed upon the Chancellor by the engineering industry for some considerable time without any reasonable result.

We must differentiate widely between those profits extended in dividend and those ploughed back into industry. The present differentiation conceded in the recent Budget is far too small a "carrot" to achieve the purpose.

INCENTIVE FOR MANAGEMENT

Turning now to the incentive required in management as apart from capital or ownership, the problem is equally clear. Management (and I speak from personal experience as producer, manager and owner) is tied up

completely with the rate of growth of the organisation. Management can be provided with all the " incentive " it needs if it is associated with a healthy, profitable industry, steadily growing in size, which is therefore able to offer a continuous programme of greater responsibility, and therefore greater remuneration, together with growing opportunity of more managerial positions. I have never found a lack of the necessary enthusiasm for output in management, where such conditions apply. Conversely, there is nothing more damning to such enthusiasm as continuing restrictions to development and obvious lack of capital, and here again I speak with experience of firms employing from a few hundred workpeople to as many thousands.

From now on I am intending to deal only with the technicalities of " incentive ", as time does not permit reference to the associate aids of production such as welfare, working amenities, colour schemes, etc. etc., all of which are in some degree necessary for incentive schemes to be of full use.

On the assumption that we are considering " incentives " from the point of view of increase in output per man-hour, there is a distinct division which must immediately be made. There is the increased output per man-hour which comes from the operator working harder under a suitable incentive, and there is the increase in output which comes from the scientific managerial application of the side issues of payment by results.

INCENTIVES FOR OPERATORS

Dealing firstly with the application of incentives to operators it must be recognised that there are a number of forms which these can take.

" Fear " is an incentive which has some theoretical advantage, and finds a number of supporters. This is commonly expressed in engineering technology as " horsing " a shop, and is capable in my experience of increasing output up to 10%. It is also in my experience the most unremunerative return for effort that I know of, and can only result in the long run in continual deteriorating relations between management and men.

" Incentive " in the form of increased wages due to longer working hours in the way of overtime and Sunday work must also be considered. It has, in my opinion, only the value of producing an increased output over a very short period and is of serious use only in an emergency. It found its use in the nation's " Dunkirk " period, but almost all experienced users of labour found that the long-term results were disastrous. It is not easy to determine the most advantageous hours over which an average human being gives of his best, but in my experience a 47-hour working week is too long, and it is unlikely that an increase in working hours is the solution of the nation's need for an increase in output per man-hour.

" Collective Bonus " Schemes have been considered to play their part in increased output. Here again, speaking from personal experience of their application, I consider in the long run Collective Bonus is only another means of paying higher wages for the same amount of work. There is usually an increase in output for a short period, by which time the fact is soon appreciated that the odd slacker in a shop is equally well off as the hardest worker, and from that time output gradually drops back to its old level. At this point it is to be appreciated that it is much easier to start a Collective Bonus Scheme than to drop it.

PAYMENT BY RESULT

Finally, to my way of thinking, the only incentive worth while is piecework, i.e., payment by result, where each productive worker receives remuneration directly in accordance with his abilities.

I hold the view, therefore, that piecework is essential to an increased output, and while I am continually being told that this or that engineering industry (particularly in this area) is unsuitable for piecework, I have yet to find the case where, by suitable breaking down piecework, in one form or another cannot be arranged. Piecework has many difficulties attached to its application—it is the lack of understanding of these difficulties which stands in the way of its success. To apply piecework in the hope of getting more output for the same wages, is the most certain way of ensuring its failure.

Cheaper output comes from a source other than low wages. Mutual trust and inflexible honesty is its first foundation. Labour has unfortunately been too well versed in its dishonest, or at least unfair application, to make piecework willingly accepted. If piecework is to settle down in any organisation to a kind of competitive " catch as catch can " between worker and management, then its ultimate result may be worse than plain " time " work, and at the very least its application a costly and quarrelsome process.

With all these problems more or less clearly understood, what methods have we of establishing piecework on a satisfactory and simple basis ?

I now propose to outline a simple piecework " incentive " process which I have operated for some nine years without once having a single dispute incapable of being settled within the framework of the procedure. It is extremely difficult within the limit of my time to cover the ground in detail. I am, therefore, dealing with the essential requirements in side-heading form, with brief explanations, leaving myself free to amplify any section in answer to questions which may be asked.

INTEGRITY

Success depends upon mutual trust which must be earned by management, and which will not be accepted automatically by the employee. If management will

conclude any consideration of a piecework problem by the question " Is it fair ? "—they will be on the way to success.

Mutual trust can only come in course of time, and in my case previous experiences of employees on piecework caused them to refuse its application. They were informed that while they would continue to work on " time," the piecework scheme would operate, and while " time " wages would be paid, piecework earnings would be marked in red on the pay slips. When operators first saw a difference between earnings and pay, it was merely assumed to be part of the " catch." In due course one or more operators decided to " have a go " at it to see if the " red " figures would show results. When they did, discussion started in the shop, and soon an individual asked if he could be paid on the red figures instead of the black. Piecework had started, and soon the whole shop followed.

Today there is no single productive operation which is carried out other than by piecework.

UNDERSTANDING BETWEEN EMPLOYER AND EMPLOYEE

Each employee joining my company is provided with a booklet clearly explaining his or her place in the team, the kind of discipline expected of them, and the point at which their services will no longer be required. Above all, it makes a bargain with them on the piecework system they will be required to operate.*

The bargain is as follows :—

Piecework prices will be based upon the time allowed per article. (The fixing of time rather than prices enormously simplifies costing where the same operation may have to be carried out by varying classes of workpeople.)

Times will be such that an *average* worker can earn " Time plus a quarter." A first-class worker can earn " Time plus a half." An expert can earn up to the limit of his capacity.

All time involved in making scrap or involved in rectification will be charged to the operator responsible for it up to the limit of his bonus earnings.

Rectification is free to be carried out by any operator chosen by management, and not necessarily the operator who caused it. Any workman incapable of earning time plus a quarter under the above conditions will be considered below the standard the company is prepared to employ. Times will be fixed on the above basis by management at the inception of the operation, and subject to alteration by either workman or employer on mutual agreement or through the Works Committee on the following terms :

Where a " time " is in dispute, the operation shall be set up on a

**Note.*—All the calculations in this article were made when Union bonus minimum was 27½%. In practice, modifications have been made to meet the present minimum of 45%.

machine or on the assembly bench ready for a flying start, with all equipment available.

The operation shall be carried out by a foreman or other management nominee, and the time taken shall be checked by stop-watch by the workman.

Twice the time taken under these conditions shall become the time allowed.

This is the crux of the whole piecework system, and some explanation is necessary. Some method is essential to avoid price bargaining. From the operator's point of view, the effect of using a stop-watch instead of having it used on him is acceptable, and while most of us hold the view that the " boss " is not as clever as he thinks he is, it is obviously impossible for an operator not to be satisfied with twice the " boss's " time.

From the management point of view, if at first double the actual time seems more than generous, it must be remembered that very rarely is all equipment available when wanted, that operators cannot and do not work continually, and that the nominee can have ample practice before establishing the " time." Practice of the method has shown that the basic bargain of time plus a quarter to the average man is almost exactly achieved.

This procedure, based as it is upon the principle of leading, and not pushing a man, allows every possible scope for new " times " following new methods, materials and tooling.

PROMPT PAYMENT AND DETAILED MAKE-UP

Hope continually deferred is the quickest way to kill enthusiasm, and it is essential that a procedure should be adopted whereby bonus can be paid promptly. Where bonus cannot be paid at the end of the first week, i.e. where the size of the job is such that it cannot be completed and passed through inspection, then it is desirable to pay 75% of the bonus that would have been earned had all articles passed inspection.

On the completion of the job, a debit or credit is made to the operator. He is thus kept continually interested, no matter how long the job lasts.

It is equally important to let an operator know exactly how much bonus he has earned on every job he does, and the pay slip must, therefore, be made out in such a way as to show this clearly.

INSPECTION DEPARTMENT

It is essential that the Inspection Department shall operate in complete fairness to management and worker, and nothing is more fatal to co-operation and mutual trust than continually turning down part or whole of a man's work without giving him the opportunity of knowing why.

In practice the right kind of balance is achieved by two simple

rules. The Inspection Department should not under any circumstances be under the control of the Works Manager, (it is poor psychology to expect any man, however competent, to be continually in the position of rejecting his own work). The Inspection Department should be in direct control of management, and any article having passed to Inspection, should cease to be under the control of the Shop. Secondly, Inspection records should show the precise operation at which acceptance failed.

A knowledge of the first procedure gives the workman faith in the intentions of management, and the second provides him with proof in convincing form.

SIZE OF THE "CARROT"

In terms of incentive for ownership and management, we have talked of the "carrot" not being large enough. Equally, if not more so, it is essential that the size of the "carrot" for the pieceworker should be large enough. Trade Union procedure now necessitates that the average bonus paid to an individual in a piecework shop shall not be less than 45%. Any attempt to limit the bonus to this figure will only result as previously suggested in paying more for the same work.

It must be clearly established that there is no limit to what the expert can earn on a time based upon the ability of his average workmates.

*Any piecework system that is resulting in a total shop bonus of less than time and one quarter is on the way to failure.

†Given proper security in fixing "times," proper team work on the part of management and men, then the best results will be obtained where the average is in the order of "time plus a half."

If only those responsible for management would realise that with the security of a fair price agreement, and with shop oncost greater than 100% of nett wages (as it almost invariably is) then the more bonus earned the more profit the company must make. Total Works Bonus in relation to nett wages is management's surest weather cock, added to which it must be appreciated that high wages mean high purchase power, and, therefore, the ability to purchase the greater quantity of goods manufactured.

KNOWLEDGE OF RESULTS

Finally, the operator, if he is to take his place in the team, must, in addition to knowing his own bonus results, know also whether the team is winning or losing, and some method must be adopted to indicate to the workpeople the output shop by shop of the whole works in relation to the works' commitments to its customers.

Note.—To meet present Union minimum of 45% Bonus rate read for today's practice :

* Time plus one half. † Time plus two thirds.

We are achieving this result quite simply by running a monthly output competition of the whole works against " bogey." Each Shop is shown separately so that if the works lose, the Department responsible can be seen. The results are shown graphically and if the works win, every member of the company is given a packet of 20 cigarettes. Input and output is measured in Works Units, and bogey is easily arrived at.

As will be seen later for quite different reasons, nett time wages paid are kept separately from bonus and overtime premiums, so that the total nett wages paid for the month equals the total " time allowed," less a 25% allowance for bonus. Therefore, if the total output has been achieved with a bonus of 25% or more after deduction of scrap and rectification times, then the shop output will beat the " bogey."

The foregoing outlines a successful incentive scheme based upon payment by results. Let us suppose at this stage that this is in satisfactory operation. What output results will it bring us?

If operated to the mutual satisfaction of both parties working as a team, increases of up to 60/70% in output per man-hour can be expected. If worked to the satisfaction of neither, output may in the end be no better than time work at a considerably increased cost. Assuming the more satisfactory result, is this the end of payment by result?—most people expect that it is. Personally, I view it merely as a beginning, and a very small beginning at that. Certainly not more than enough to bridge our industrial economic adverse trade balance.

I believe if at this stage management collects the fruits of a successful payment by results scheme, output can systematically be raised by 100%, 200% or even 300%, and if adopted by all sizes of industrial management, can once again place this country at the head of the world's producers—America not excepted.

How then are these fruits to be obtained? There are three broad essentials to be considered :—

(*a*) Piecework reaction.
(*b*) Suggestion Schemes.
(*c*) Cost Analysis.

PIECEWORK REACTION

No matter how excellent the rate fixing system may be, there will always exist in any piecework shop the " good " job and the " bad " job, that is to say, where the time fixed is easy money to the operator, and only just fair, respectively.

The obvious and immediate result is for the operator to try and " work " his time sheet by transferring time from the too good job to the poor job in the fear that too large a bonus will result in a price cut. Alternatively, transfer time from the harder task to

provide only " time " payment, and obtain additional increased bonus on some better time job. Exact costing is essential to cost analysis, and some watertight method suited to the shop must be devised to make " time " transfers impossible, and strict discipline enforced to see that the procedure is adopted. With this point fully ensured, we now come to the next and most important point of piecework reaction.

If a man is paid by " time," he will be prepared to accept almost any kind of job or difficulty so long as he is paid for it. Such of his work as is unnecessary from the point of view of output is completely incapable of being picked up by cost analysis, and possibilities of improvement are therefore taken out of the hand of management and transferred to the lowest but one grade of production personnel, i.e. the chargehand.

With piecework the position can be entirely reversed. If an operator is given a task as for example the assembling together of two parts A and B, with a time based upon the correct fitting of the two parts, he will have a legitimate complaint if the two parts do not go together easily. Under most piecework systems the generally accepted procedure is to tell the operator he must take the good with the bad, and get on with the job. This is the easiest way out, but is entirely wrong from many points of view other than the one I am dealing with now.

The operator should be encouraged to object to difficulties outside his piecework bargain, and the foreman or chargehand should be provided with a Foremen's Order Book, with serialled pages, so that he can on his own initiative give to the operator an order covering the additional work, with a detailed reason for the need of such work.

The actual cost of such additional time, which in any case will be charged to " oncost ", is of no importance provided the correct follow-on is adopted with regard to the foreman's orders so issued.

By the mere transference of such orders to management for approval of cost allocation, we have at once the position that any appointed person, from the Managing Director downwards is made aware for the first time that something is capable of improvement—the Inspection Department for instance, if the parts were incorrect to drawing, an incorrect tolerance, inadequate tools or jigging. In fact, almost any conceivable fault.

I cannot stress too strongly what results can be obtained by consistent automatic consideration of a continuous series of small difficulties, any one of which by itself is almost too insignificant for notice. Here you must use your own experience and imagination, while remembering that four unnecessary strokes of a file by a fitter, multiplied only by some thousands of articles per annum, means real money in loss of output.

You will see, therefore, that I am advocating a procedure whereby the operator is enabled to help management while helping himself. To quote a typical if extreme example, I have in mind an article that cost 3s. 11d. to assemble on "time," the operator receiving something in the order of £5 per week. Under piecework on the lines I am advocating, and over a period of years, the same article is being assembled today for 9¾d., and the operators earn between £8 and £11 per week. The total sales turnover of the same article by virtue of its better finish and interchangeability and lower price has in the same period risen by over 200%.

SUGGESTION SCHEMES

There is nothing new in the principle of the Suggestion Scheme, but there is, however, considerable variation in the results obtained.

Properly handled, I consider it invaluable and hold the view that the actual operator has many opportunities of seeing difficulties not apparent to the Designer or the Production Engineer. Two major points are essential for its successful operation.

First, foreman obstruction is a cause of the failure of many schemes. Often the foreman does not view a suggestion with any enthusiasm, either because it is too much bother, or more often because he feels that the suggestion should have come from himself, and is therefore a reflection on his abilities. Let the foreman share suggestion payments.

The second consideration is one of acknowledgement. Many suggestions are useless or impracticable for some reason not seen by the operator. Every single suggestion is acknowledged in writing to the operator and signed by a Director, and reasons are given as to why any suggestion is not applicable, often in complicated cases followed by demonstration to the operator in the shop. Where suggestions are accepted, they are acknowledged both in terms of words and money. Acknowledgements of from 10s. to £500 have been paid by us, and on an average 15 suggestions are dealt with per month.

All this is part of the procedure of making the operator one of the team, and may occur to you as being a lot of trouble. It is, but it is also worth a lot of profit.

COST ANALYSIS

Here we come to perhaps the most important sideline of payment by results. The necessity of correct costs has already been stressed, but the form in which such costs are available and their relation to piecework has yet to be considered. Costing in the sense which we are to consider is impossible on the basis of time work, as any experienced Cost Accountant is aware, but costing on a piecework basis can be just as useless unless the fundamental requirements are clearly understood.

For what purpose are costs required? Certainly not in 99 cases out of 100 to fix the selling price of a given article. Selling price is fixed by the competitor/user association, i.e. by supply and demand. Certainly not to ascertain whether an article already sold has been sold at a profit. This is negative costing, as once an article has been sold the contract is closed, irrespective of profit or loss.

Rather, then, is costing required by management to provide against a given market selling price, the data necessary to produce the components of the article at the lowest possible price for a given quality, largely, that is, to reduce the labour costs per item, which is equivalent to increasing the output per man-hour.

The provision of a single cost figure is useless, and the essential of all costing is that it provides a basis of comparison. For example, no useful purpose is served by knowing that labour lost on producing scrap is say £100 per week, but vital information is available in the comparison of such figures month by month, in going steadily up or down or widely fluctuating.

Let us examine, therefore, this question of comparative costs. Let us assume that on a given operation, a time of one hour is allowed, and that the task is such that an average operator can earn time plus a quarter, also that the wages per hour are 2s. and shop on cost 200% on labour, and the value of material 1s. 6d. This job is to be performed and costed, and the factory cost submitted to management for analysis. To provide the basis of comparative costs, the job is to be performed by a number of different operators under varying conditions :

A. An expert operator earning double time and no production accidents, the job is done in 30 minutes. The cost would be :

30 minutes on the basic rate } Labour		
30 minutes bonus } involved	...	2/-
Shop oncost at 200%		4/-
Material		1/6
Total Factory Cost		7/6*

B. An average operator and no production accidents, the job is done in 48 minutes, and the operator earns quarter bonus.

48 minutes on basic rate } Labour		
12 minutes bonus } involved	...	2/-
Shop oncost at 200%		4/-
Material		1/6
Total Factory Cost		7/6*

C. A poor operator only capable of earning time, and no production accidents—time taken one hour.

*The figures marked with an asterisk will be those submitted for management analysis.

60 minutes on basic rate	2/-	Labour
Shop oncost at 200%	4/-	
Material	1/6	
Total Factory Cost	7/6*	

D. Material scrapped halfway through and replaced, but job completed in one hour by skilled operator.

One hour on basic rate	2/-	Labour
Shop oncost at 200%	4/-	
Double material	3/-	
Total Factory Cost	9/-*	

What can management analysis make of these figures, i.e. 7/6, 7/6, 7/6 and 9/-? I do not know, but if I had to make a guess it would be on the basis that the shops had produced a splendid performance for three jobs, but had had an unfortunate accident on the fourth.

As Sales Manager I might be justified in assuming for compilation of price, an average cost of 7/10. As for the rest of the comparison from the point of view of increase in output per man-hour it is just so much useless figuring, yet these are the kind of costs that are produced in many concerns all over the country. Time does not permit of a detailed analysis, but taking cases A, B and C, for a factory cost of 7/6 we have recovered a 4/- oncost on each article for 30 minutes, 48 minutes and 60 minutes of machine time respectively. Obviously something is wrong. A hundred different combinations of workmen's abilities, production of scrap and overtime premiums, etc., can, under these methods, give the same result.

Costing must be accurate, simple and comparable. Let us therefore adhere to fundamentals, and consider these points :—

1. The selling organisation cannot say to a customer : " This article will cost 7/6, if we happen to have one of our best workmen available, but 10/- if not." So *bonus* must be excluded from costs and treated as an " Oncost."

2. The selling organisation cannot say to a customer : " This article will cost 7/- if done on the day shift, but 10/- if done on the night shift." So overtime and night work premiums must be omitted from costs, and treated as an "Oncost."

Here it is necessary to note that if overtime or night time premiums are a less percentage increase on wages than the percentage oncost on labour (as they always are), then a job done on overtime or night-shift is cheaper and not dearer to make, provided that the day-shift load is full.

*The figures marked with an asterisk will be those submitted for management analysis.

3. The sales organisation cannot say to a customer that they are sorry but the price of 7/6 must be increased due to a workman scrapping some material. So *scrap* must not be included in costs, but treated as an "oncost."

If, therefore, only the material which should be used on an article is included in costs, then all material can be excluded from the Shop Cost Department, and added by the Sales Department or Records Department from calculated material costs. Shop costing and analysis is thus related to production wages only, and costing becomes much more simple. On these lines we can now compare the production costs of any job, as for example, in cases A, B, C and D, inserted into a standard Cost Analysis Sheet.

At this stage we have merely achieved a mechanical division of costs in such a form as are capable of comparison later, but we have at the same time laid the foundations of two major steps in Management control of output per man-hour, i.e. "Factory Control" and "Production Control."

FACTORY CONTROL Reference is made above to "cost allowed." We have already agreed that the time allowed shall be such as to give an average operator time plus a quarter.

Cost allowed, therefore, is four-fifths of the time allowed in terms of the operator's basic rate, i.e. the exact nett wages cost if the operator earns time plus a quarter. (Note : Should a variety of operators, such as boys, girls and men be employed on say a milling section, then the average rate per hour of the section is used.) £1 worth of cost allowed values are for convenience purposes referred to as one Works Unit.

As the summation of the Works Units of each operation gives the total Works Units involved in the production of any article, no matter how complicated, we have a "yard stick" with which to run the whole processes of managerial control.

SALES CONTROL Selling price is immediately arrived at from the estimate stage based on nett labour, i.e., Works Units, with the assurance that each time the article is produced, Works Units will become nearer the exact cost.

A decision to increase the sales of an article X by say 20% gives immediately the extra Works Units involved per month, and as these can at once be reviewed in terms of individual machine sections, for example, ten more units for drilling section, 50 more units for capstan section, etc., it is possible in the same day as the sales decision, to decide exactly what, if any, extra machine capacity will be required. While the sales personnel are seeking the new volume of orders, new plant has been ordered, and is in

course of manufacture, and new levels of material required, requisitioned. And so at the earliest possible date a managerial decision can be turned into active production.

WORKS CONTROL A summary of the total monthly production from the Cost Analysis Sheets is provided to management every month. Immediately, therefore, month by month the direction of results in simple form, upwards or downwards, is ascertainable for the following uses :—

Bonus

The bonus in relation to time wages is apparent. A falling bonus is the surest indication of coming trouble.

Overtime

Some overtime is nearly always essential.

Consistent overtime of too great a volume means tired labour and poorer returns, while a growing overtime bill indicates an overloaded factory, and the need for sectional investigation.

Service Wages

The monthly service wages bill in itself is of little importance, but its movement upwards, if not compensated by increased output, necessitates immediate consideration.

Scrap and Rectification

The monthly comparison of these figures speak for themselves.

Input

Every single article sold is in terms of Works Units, and the total input of work to the factory known on a comparable basis.

Output

As output of articles passed Inspection is also on the same unit basis, the catch up or fall back of the factory is immediately apparent and the necessary steps can be taken by management to correct the position.

As in fact a month is too long an interval for Management to become aware of output, these figures are available every Monday morning for the preceding week so that the Managing Director can be aware of any trend in the shortest possible time.

WORKS BOGEY OR TARGET As the nett wages are equal to the Works Units, provided that each operator earns " time plus a quarter," and no scrap or rectification is effected, it becomes apparent that the output in terms of Works Units will be greater than nett wages if the bonus earned in excess of " time plus a quarter " is not more than offset by loss due to scrap and rectification.

It is, therefore, possible to give the Works a target, or if preferred, as in our case, every Department, or indeed, if required, every

machine section. This target is merely the Works or Departmental nett wages expressed in Works Units. The successful Department or the Works can be compensated for beating the target in any number of ways, depending upon the policy of the Company—in our case by the presentation monthly of a packet of 20 cigarettes to every employee—office staff included—if the Works beat the target.

Every essential form of managerial remote control can be exercised on examination of these figures, and the necessary direction of managerial pressure, or preferably leadership, is apparent month by month.

PRODUCTION CONTROL

Production control is exercised from the Factory Analysis Sheet. Primarily it affords direct Works Management an opportunity of investigating trouble jobs almost as soon as they have been completed. The certainty that at a later date these will come under review of management helps to keep Works Management on its toes.

The result of each job is transferred from the Cost Analysis Sheet to a Factory Cost Record Card by a Records Department, and on the completion of three sets of costs, the Factory Cost Card is analysed. Again by comparison methods, each Card is analysed in relation to the following points :—

1. The cost incurred is compared to the cost allowed, and if the record shows that the time allowed is incapable of " time plus a quarter " bonus, then the time is increased.

No reduction is made for excessive bonus on individual items. Excess costs are left to accumulate until on a given product they effect profit or sales, when the whole costs are reviewed through the Works Committee.

2. The percentage number of articles passing Inspection is examined in relation to the actual operation causing the largest number of rejects. A difficulty, for instance, arising out of a " tolerance " is discussed with the Engineering Department, with a view to a modification.

Should this not be possible, new methods of production are devised, or new jigs and tools provided.

3. Standing time due to setting up is examined, and where excessive, operations may be reversed, or altered, or where desirable a pre set-up rig is produced and kept for that particular article.

4. Finally, the whole result is examined together with the drawing of the article in the light of any new material, machine or

process which has become available since the last time the card was examined, with a view to seeing whether the production time of the article can be reduced, or the overall cost cheapened.

In our case, it must be appreciated that for every penny saved on the basis of all items produced, an additional profit of over £2,000 per annum is made.

OVERALL RESULTS

Apart from the inestimable value of precise managerial control, the fact that management is able to make detailed consideration of every item produced at least once a year means that, step by step, and perhaps only coppers at a time, the cost of production is reduced, and the output per man-hour increased.

It would be possible to give literally thousands of examples of how management control of this order can increase output per man-hour far above anything that could be possibly expected by mere incentives to labour. The most convincing proof, however, is the total results as shown in the outgoing sales and output per man-hour graph over a number of years.

OVERALL COST

The description of cost analysis may seem complicated, actually it is extremely simple, and brings the whole process of routine costing within the range of inexperienced personnel. The cost may well be less than the usual methods of cost recording, and here again actual results are the best proof.

The following figures give the overall cost of the system, and are compiled from the total wages bill of each section in relation to the total turnover.

Inspection Department	2·175%
Cost Department (including the making up of all wage sheets, but excluding the making up of pay packets)	·65%
Cost Record Department	·37%
Total	3·195%

DISCUSSION

Mr. D. F. H. RUSHTON (North Eastern) said that the object of a bonus incentive must be to improve efficiency. It was not a substitute for good management, and the bonus must be kept separate from the basic rate. The basic rate was intended to represent a fair day's pay for a fair day's work, and the bonus should be for something in excess of a fair day's work. It must be based on

measurement, which might be developed from a very simple measurement to a more accurate one as time went on. His Company had done their best to eliminate the incentive of fear by guaranteeing to give any worker who had been with them for more than two years, 34 weeks' work in any one year.

Mr. A. SYKES (Halifax) suggested that many indirect workers, such as the man who removed the swarf, should be included in the bonus scheme, as they all had a contribution to make. Inspectors should be included, but not in the same scheme as the men whose work they inspected. The purpose of an incentive scheme was to see that the machines worked harder. An individual scheme, where it could be applied, was better than a collective one. The rate-fixer should be encouraged to be unbiased. In fixing rates, excessive times were as bad as insufficient times, because the men felt that their work must bear some relation to the time set. Where quantities were small and the work varied, it was better to pay a good workman a high day rate than attempt to set piece-work prices.

Mrs. A. P. OPPENHEIMER (Glasgow) maintained that the principal object of any incentive scheme should be to gain increased worker co-operation, and fear should have no place in it.

Mr. R. E. GREEN (Birmingham) said that in the chain-making industry it had been found that beyond a certain point no incentive scheme had any effect ; the workers felt that they had made enough money and preferred their leisure. It was not a question of income tax.

Mr. A. P. OPPENHEIMER (Glasgow) pointed out that where a bonus was attached to the making of a particular component, regard must be given to the effects of growth of experience and change of method. No money incentive should be introduced until the procedure had been settled. For an individual monetary incentive it was necessary to be sure that the job was done completely, that there was a definite way of checking the number of pieces ; there must be a check on quality, and the operator must have fair control over the rate of output.

Mr. E. BARRS (Nottingham) said that his firm paid a 5 per cent bonus in share units to all non-piece workers, including inspectors, and to everybody in the factory, with the result that the men chased the charge-hands, the charge-hands chased the foremen and the foremen chased him. When, in order to reduce prices, he asked his people to agree to a 12½ per cent reduction in piece-rates, they unanimously accepted it.

Mr. F. WHITEHEAD (Liverpool), who mentioned that his firm operated a scheme which brought in everybody, said that there was still something lacking, and he thought it was the shortage of goods which people wanted to buy.

Mr. M. CARTER (Preston) emphasised the great difference

between a large and a small firm. In a small firm the personal touch was important; in the large firm, an unlimited financial incentive should be given where possible, and some progressive firms adopted a profit-sharing system.

Mr. B. H. DYSON (London) said that direct producers usually represented about 40 per cent of the total employees, and he was interested in the incentive for the other 60 per cent. The jig and tool designer, for instance, could do a great deal to cut down the time of a job. One of the strongest incentives was satisfaction in achievement. The British workman appreciated quality, and any payment by results scheme which did not take account of quality was faulty.

No standard set for an individual scheme was applicable six months later, and they had found, taken over a number of factories, that a group system would give an increase of 8 per cent over an individual system. On several occasions they had taken out whole jobs from a group incentive system to a factory with no incentive scheme and found that production increased by 11 per cent. That was due to the desire for achievement of people who were paid a weekly salary. The insecurity of hourly payment was due to be discarded; the time would come when the workers would be paid a weekly or even a monthly salary, and that would help to get rid of fear. Even when on piece-rates, workpeople fixed a ceiling to their earnings as a result of fear. Incentives must not be used to bolster up low wages.

Mr. J. BAILEY (Halifax), speaking with thirty years' experience of a firm with a profit-sharing scheme, said that it narrowed the gap between management and producer and, by enabling thrifty people to become part-owners of the firm, created an entirely different atmosphere in the works, doing away with the need for iron discipline. In any piece-work system a bonus should be paid to the skilled worker at least equal to the average bonus earnings of the semi-skilled.

Mr. A. P. RAWKINS (Manchester) argued that profit-sharing, while satisfactory as long as a good profit was being made, bore no relation to the effort of the workers in bad times. In inefficient factories, where the output of a man was only one-third of what it should be, a bonus could be paid for any increased output but so arranged that when the men worked at a speed which merited time and a third they would get it. When men saw that they were earning a bonus they would increase their speed of work.

Mr. M. SEAMAN (London) said that the factor of community of interest could not be ignored. The shareholder, the manager, the technician and the worker all needed an incentive, which must come from the margin after the final return of costs had been made. A developing practice of many English firms was to pay up to two or

three weeks' wages and salary as a bonus, while there were American firms which paid up to 100 per cent of the yearly earnings of their operatives.

Mr. POWELL (London) expressed his belief in the system of direct payment, so that a man knew at the end of the week exactly how much money he had earned. He had worked with that system both in this country and America and never had any labour troubles. The senior executives received a bonus on the gross profit of the company, and others not working on machines had a bonus based on the monthly output related to profit.

Mr. MCFADYEAN (Manchester) said that to assist small firms the Institute of British Launderers had a staff of time study workers who would go to any firm, while work study schools were run by the Cotton Board for the cotton industry. He was opposed to pension schemes, which prevented men who would do better work going elsewhere. A bonus scheme need not be based entirely on output, but could be related to rejects, scrap produced, and quality. He deprecated the payment of a bonus higher than 50 per cent.

Mr. R. W. MANN, replying to the discussion, said that the real value of piecework was that it provided a basis for costing and the only way of ensuring a fair day's work for a fair day's pay. In his company they never timed a man with a stopwatch ; they had a bargain with their workpeople to fix a time so that the ordinary man earned time and a quarter, the good man time and a half and the expert what he could get. They had an agreement on how the time should be fixed, and the workpeople could ask for a re-fixing of the time whenever they wished. They practised in the Research Department until they found the best way to do a job, and then told the men that it took the boss four minutes and that they would allow eight ; by and large, doubling the test time gave the result desired. Whenever the method was altered the job was thrown open to re-testing, and they were able to cut prices, based on new methods, at the rate of 30 or 40 a month with the full co-operation of their workpeople.

They did not pay bonuses of any kind to non-producers ; the inspectors were paid wages higher than those earned by any men under them. He believed that fear must form a part of the incentive, in the sense that it must be possible to say to a man " Bill, you don't like working for us and we don't like you working for us ; you've had it." It was not fear of being unjustly treated, but fear of what would happen if a man did not give a fair return for a fair deal.

Mr. M. SEAMAN (London) summed up the discussion, on which he afterwards reported at the Third Plenary Session.

DISCUSSION GROUP 'G'

HOW TO APPLY IN INDUSTRY THE KNOWLEDGE GAINED FROM PRODUCTION ENGINEERING RESEARCH

by W. P. KIRKWOOD, M.I.Mech.E., M.I.Prod.E., Vice-President, Glasgow Section. Production Engineer, Albion Motors Ltd., Glasgow.

Chairman: F. T. NURRISH, M.B.E., M.I.Prod.E.
Group Reporter: A. L. STUCHBERY, M.I.Mech.E., M.I.Prod.E.
Rapporteur: D. H. TURNBULL, A.M.I.Prod.E.

THE application of knowledge gained in Production Engineering Research is fully as important as the research itself. In fact, it is more important, as research is only the means while the application is the end. At the present time there is a vast amount of information which is not being applied generally, and it is suggested that the first objective should be to use fully what is already available.

Research can be divided into three general groups :—

1. Work undertaken by Research Associations, the information gained being circulated usually to members of the Association only.

2. Research carried out by special Research Departments in large organisations. This, in many cases, is published either in the technical press or in papers to technical institutions, but obviously much work is done in such Research Departments which does not get published in any detailed manner.

3. Research carried on by normal organisations in the ordinary way of doing the job. Here the experience gained is very seldom published. It is true that the technical press publishes articles from time to time, but it is suggested that these cover only a very small percentage of the total work which is being done all over the country. In addition, many of the articles are written in such a way that it is not possible to use the information given directly without extensive further tests in one's own organisation, as vital information—which is required if all the facts are to be clear—is lacking.

THE VITAL APPROACH

The volume of information in the third category is probably far greater than in the first two. It would therefore seem very desirable that an attack should be made on this aspect of the application of research.

It is not suggested that new and possibly fundamental research should not be pursued vigorously by organisations capable of carrying it out ; this is very necessary indeed, but the research done in the ordinary firm also requires bringing together, certainly editing and publishing in a form which will enable industry to take advantage of work which has already been done.

It may be said that the publication of information gained in any one organisation is going to put them in a less favourable position when such information may be used by other concerns which are, in fact, their competitors. Experience would seem to disprove this completely. The very fact that organisations—which on the sales side are competitors—are members of the same Research Association and obtain the same information, is one answer. Another is that in many cases personal contacts between members of different organisations on the production side mean that, in fact, the information is available if it is asked for.

This request for information is nearly always met with a very full reply, but it is not always possible to know what the other man is doing ; he may be working along lines parallel with those on which you are working but unless this personal contact is made, it is not revealed.

Many problems are common to a large variety of firms, either in a particular trade or in a particular district ; these can be associated with the use of certain materials or the manufacture of certain products. What is required is that the common problems should be brought together in such a way that the results and information available in each individual concern can be made available to all. To do this, it is obvious that some co-ordinating body of the proper standing should be able to get such information, correlate it and issue it in a form which would enable the various people interested to find out how they stand in regard to any particular problem. Are their results as good as the best, or is there something which they can do better ?

Another aspect of this approach is that it stimulates the various people who are concerned in the production side of industry. No one likes being at the tail end of the queue, and it is obvious that if improvements have to be made, then each man wants to contribute his quota to the common good. An engineer interested in production rarely visits a firm other than his own without seeing something of interest. Usually he sees something which is being done better than in his own works. He therefore applies what he has seen when he goes back.

In many cases direct application is not possible. It may be only the principle involved which can be applied. The surrounding

circumstances may be very different but the application of the solution noted in the one case may be just what is required in the other.

COLLECTION OF INFORMATION The type of co-ordinating body which is best fitted to carry out this work is one which could be profitably discussed at length. Two solutions occur :—

1. The handling of the whole subject by means of a special group controlled by some research organisation such as P.E.R.A.
2. By teams working as in Anglo-American Productivity Teams, to be sponsored by the industries concerned.

In both these cases the suggested method of working would be similar and the procedure envisaged would be on the following lines :—

1. Visits to works which could reasonably be expected to have like problems.

2. Discussion of these problems.

3. Obtaining the various solutions reached in the various organisations, with records of the failures as well as the successes. The former is important, as if a method has previously been tried by various people and found to be unsatisfactory then it is obviously a waste of time to pursue it, unless some new feature can be introduced which might be able to turn the previous failure into success.

4. The drawing together of all the solutions of the problems which have been obtained, and the examination of the results.

5. Getting explanations for apparent and real discrepancies. This might be one of the most difficult stages because the manner in which a problem is tackled can yield varying results. At the same time, this stage cannot be neglected as it is usually this aspect that causes most trouble. In the application of published results, too often the information given has seemingly glaring discrepancies which have to be resolved. Much time can be wasted in trying to get results and achieve success when a comparatively simple explanation may be all that is required.

6. Circulation of results.—Here again the easy way will not achieve success. The form in which the results go out has to be carefully watched. The amount of information given should be the minimum, so as not to swamp the receiver with anything other than that required. At the same time, nothing relevant must be left out or the queries mentioned above will surely arise. The results should obviously be summarised in the first instance, so as to show what may be expected, thus enabling those receiving them to compare the best achievement with their own. Very often it will be the case

that their own achievements fall short, and this report supplies the spur to go into the matter and take full advantage of the experiences of others.

APPLICATION OF RESULTS IN THE FACTORY

In factories there is a wide spread of interest. It is, therefore, desirable that the reports on the various subjects should be circulated as far as possible, in the first place to stimulate the interest of various departmental heads who may be involved and also their staff, but in addition, each department looks at the problems from a widely different angle. It is well, therefore, that all should have an opportunity of seeing what is being done elsewhere.

The general responsibility for implementing any worthwhile suggestion should lie, of course, with one person. In most cases this would be the Production Engineer, or the individual carrying out the duty appropriate to the name. On him should rest the decision as to what results are worth applying although, obviously, all who have read the reports should be in a position to put forward their views. Where the organisation is big enough, the actual channel through which the research results are put into practice can be subdivided into sections. A medium-sized works might have three. These could be—

1. Metal Cutting.
2. Metal Forming.
3. Material Handling.

In a small organisation one individual would cover all aspects of the application of research results. In a big organisation half a dozen or a dozen men might be needed. The main point is that it should be the definite responsibility of one individual to see that the results are carried through to completion. This is regarded as absolutely essential. There is no truer adage than the old one that "What is everybody's business is nobody's business."

SUBJECTS OF COMMON INTEREST

There should be no lack of subjects of common interest which would enable such a circulation of research results and practice to be started on a broad footing where the information given could be applied in a very large number of organisations, particularly in the engineering industry. The subjects should cover as wide a range as possible. Three completely different subjects come to mind as being of general interest but no doubt very many others can be suggested in the discussion. The three are—

1. *Drill Sharpening.* There is no doubt that although this is a commonplace operation in all engineering factories, even to-day

many drills are not properly sharpened. The methods of sharpening and the service behind the sharpening can be recorded in various factories, thus enabling the best methods to be at the disposal of all.

2. *Service Cranes for Machines where Parts are Heavy.* There are many ways of handling heavy parts at machines, ranging from the getting of two stout labourers to lift the part on to the machine to the flexible light cranes which have got coverage over an area, but can still be handled quickly and easily by the machine operator without outside assistance, but which still seems to be almost unknown in this country.

3. *Shaft Turning.* Most firms have to turn shafts of various sizes with many diameters. There are certain recognised methods of doing this, ranging from the simple centre lathe through capstans to the copying lathe and the multi-tool lathe. The method is determined by the quantities available, the material and the slenderness of the shaft, but there should be no need for the economics of various methods being examined in each case. There is sufficient data and experience in the country to make reference to a report all that is necessary, provided the report sums up the known experience in this class of work in a properly tabulated form.

Many other common problems exist and it is at Conferences such as this that there is an opportunity of wide interchange of views, so as to initiate means of dealing with them and applying the results of the work of others. This is the essence of the Research Science.

PROGRESS ALREADY MADE

A start has already been made in P.E.R.A. to bring together subjects of common interest to various groups within its membership. This is being operated by means of panels, each covering a specific section of industry.

The panels meet periodically and discuss the problems which are common and which seem most urgent of solution. The result of the work of the various groups is then correlated so as to form a guide as to the future research of the Association.

An extension of this could easily be made, so that the information already available in the individual organisations could be dealt with in the way described.

Information in the various technical publications is well covered in the abstracts which can be used to supplement the normal reading of such journals. These abstracts also form a ready means of bringing together the available information on a subject. Only the very large organisation can operate an efficient library system. The ordinary firm must, therefore, use a Research Association such as P.E.R.A. to give this service.

CONCLUSION It is hoped that the short survey of the position which has been given, and the suggestions of dealing with a very real problem may stimulate discussion from which may come a solution which will help us all.

DISCUSSION

MR. NURRISH opened the discussion by pointing out that P.E.R.A. made available to industry publications and bulletins giving practical information. He stated that the right application of the principles involved in any invention was necessary : he instanced a soldering technique which was wrongly applied in its essential details and finally discarded owing to this non-attention to detail.

He went on to say that he had some misgivings on the advisability of throwing open factories to competitors ; much money was often spent on the perfection of methods by the firm concerned, and he did not think it right to make this information available to others without their participating in the cost involved.

DR. H. SCHOFIELD, C.B.E. (Leicester), who was called upon by Mr. Nurrish to start the discussion, said that he thought much could be done to effect liaison between the Universities and industry by men returning to the former from the latter, and he would like to see Cambridge adopt the same principles. He would also like to see P.E.R.A. staff more in the field of industry, applying their findings in a practical way.

Mr. R. SHILTON (Leeds University) stated that he was busy on the innovation of Production Engineering as a subject in the B.Sc. (Engineering) Course. He had carried out a great deal of research into London University files for papers on pure production, but, apart from those of Dr. Galloway, there was a distinct shortage of such papers.

He believed that there was much confusion between what was known as " Workshop " and " University " research. He was instigating research into metal cutting, machinability and grinding processes.

MR. W. ARMSTRONG, M.B.E. (Yorkshire) supported Mr. Shilton in his work and deplored the leisurely attention generally given to industry by the Universities concerned. Much time was frequently lost between the investigations being made and the publication of the results, so that the latter had become out of date. Closer contact was definitely needed, and industry would welcome any offer of closer co-operation by the Universities.

MR. SMITH (Birmingham) said that he paralleled the University research and industrial requirements with the parable of the heavenly story without an earthly meaning ! Practical requirements of industry, such as tool life and chip flow—to mention two—were not forthcoming from the Universities.

MR. TARRANT (Manchester) said that his group of companies was offering scholarships to its executives for a three-year M.Sc. Course. However, a difficulty was being experienced in the salaries to be offered to University-trained men as against the salaries being paid to men of practical training. He asked Dr. Schofield what suggestion he could make to meet this situation.

COL. C. W. MUSTILL (Yorkshire) said that there was a big difference between fundamental research and applied research. He could not emphasise enough the desirability of closer contact between industry and University on lines parallel to those in operation in the U.S.A. He also advocated more frequent visits to Universities by industrialists and their executives.

DR. SCHOFIELD agreed that applied research was not fundamental research.

He wished that English industrialists would give the Universities similar support to that given by the Americans to their own Universities, and instanced the gift of 6,000,000 dollars to the Massachusetts Institute of Technology. This money was given with the object of meeting the practical needs of industry without too much stress being placed on the academic side.

He could not give an answer to Mr. Tarrant's query, but advocated that University trained men should accept a nominal salary to begin with, and earn their increments.

MR. A. SEWART (Manchester) instanced a case of industrial executives going back to the Universities, and said that it resulted in three more Professors for the Universities and not the help to Industry as was intended.

He did not think that competitive industries had anything to fear in opening their doors to each other, as the more progressive would always be two steps ahead of their competitors.

MR. KIRKWOOD here stated that he had not mentioned the Universities in his paper because of their lack of a practical outlook, and it was a long-term project to instil the new outlook required by industry into the Universities. He realised that P.E.R.A. Panels were operating along the lines given by Mr. Nurrish.

MR. H. FOSTER (Sheffield) said that his company engaged college-trained men and gave them from one to six years in the American Universities, in the hope of benefiting on their return. His firm believed in the practice of the " open-door " policy.

MR. A. SYKES (Halifax) said that fundamental research in the Universities must end in applied research, and thought that enthusiastic interest was what was required. He felt that many men would rather fail by their own methods than succeed using those of others ! He believed that more practical applicaton was necessary rather than more research. Periodic review of innovations was essential to prevent some falling into disuse due to minor

failures which could be rectified. He also thought that there was a reluctance, by many firms, to release men with practical training to the Universities.

MR. R. HUTCHESON (London) agreed that University research findings should be published. He spoke as a working journalist, and stated that although machinery was available for the dissemination of results, there was a marked disinclination to put the " open door " policy into effect and much small shop research was not put down on paper, thereby losing a great deal of valuable information. He appealed for the publication of this material and for the publication of Institution papers.

He went on to say that basic principles could be taught on all machines, but modern techniques could only be learnt on new ones.

MR. H. BOLSOVER (London) remarked that much machinery was available in Universities which was not being used to good purpose in obtaining practical results.

MR. S. HORNSBY (Luton) said that he was impressed by the R.A.F. Aerodrome Technical Schools, and particularly by his visit to Cranfield, which was equipped with the latest machinery.

MR. WRIGHT (Birmingham) stated that, generally speaking, Chairs of Engineering were not endowed by the right Bodies ; that endowed by Lucas at Birmingham being the exception.

MR. ROBERTSON (Glasgow) requested the publication, in book form, of investigation results.

Mr. A. L. STUCHBERY (London) said that no mention had been made of the work of the National Physical Laboratory which responded to definite enquiries, even to those of small firms.

He went on to say that professional snobbery had to be guarded against—for example, Research Departments as against the Shop Floor. This position is non-existent in America, where research findings are available in reports, written in a common language which can be understood by men on the Shop Floor.

MR. KIRKWOOD replied that the National Physical Laboratory was supported by taxes and that any investigations undertaken on behalf of any individual firm had to be paid for—thus it had, in effect, to be paid for twice.

He agreed that a common language should be used, thereby avoiding complexity, and that a simple summary was essential.

MR. H. GARDNER (Glasgow) concurred with the training of engineering students as advocated by Dr. Schofield. He thought that students should have practical training in industry between the ages of eighteen and nineteen, and then be sent back to the University. He believed that much investigational work and many productivity reports had been shelved.

MR. R. NIX (Coventry) said that P.E.R.A. dealt with current problems primarily, and secondarily with fundamental research.

He felt that there was urgent need for data on new materials, now being advocated as alternatives such as feeds and speeds in cutting.

Mr. R. B. NIXON (Yorkshire) said that the technically trained man was prejudiced against the practically trained man, and this must be overcome so as to utilise the latter's experience.

MR. STUCHBERY thought that consideration should be given to the man who had to do the job, both by the foreman and the supervisor—this would result in real co-operation.

MR. KIRKWOOD said that the foreman's interest and enthusiasm for the job must be roused at an early stage thereby encouraging his full expression and ensuring that, when the job itself came along, he became its best advocate. He went on to say that it was necessary to select the right man for the job and that his pay-packet should be beneficially affected on the achievement of results.

MR. H. FOSTER (Sheffield) agreed with Mr. Kirkwood's scheme. He said that drawings and estimates issued at an early stage were an encouragement and the men in charge must not isolate themselves from the men on the job ; in this way criticism and enthusiasm could be stimulated.

Mr. F. WHITEHEAD (Liverpool) queried the correctness of the title of the paper. He stated that Universities were the places for research, and that industry should make more use of the data already available. He wondered whether dissemination of research was really the difficulty, and thought that firms were not keen on competitors obtaining knowledge of failures as well as successes !

MR. J. BAILEY (Halifax) said he would like to ask what was preventing the dissemination of knowledge and the right outlook in industry ? He considered that the work of the Institution was to put over the need for improved production for the benefit of all.

DISCUSSION GROUP 'H'

THE STATUS OF THE PRODUCTION ENGINEER IN INDUSTRY

by H. G. GREGORY, M.I.Prod.E., Member of Council. Manager (Northern Factories), Fairey Aviation Co. Ltd.

Chairman: T. FRASER, C.B.E., Hon.M.I.Prod.E.
Group Reporter: A. L. STUCHBERY, M.I.Mech.E., M.I.Prod.E.
Rapporteur: A. FRASER, M.I.Prod.E.

BEFORE commencing to lead this discussion, I would like to say that whatever may be my approach to this subject, it is submitted with the primary purpose of stimulating thought and expression of opinion, which is really the most valuable part of the discussion group.

Our problem is to endeavour to resolve the relative standing of the Production Engineer in industry. That is, the literal translation of the word " status " in the title. I am afraid that I, very naturally, have looked at this problem as it applies to the engineering industry, but mechanisation of all manufacturing industries in general is expanding, and, therefore the word " industry " covers not only engineering, but also textiles, pottery, canning, furniture, etc., to name only a few that come to mind.

Virtually, there is no limit to the extent of Production Engineering, and without the analytical study of the problems and methods of production efficiency by the Production Engineer, the worthwhile designs and technical performances are rendered less effective, with considerable loss to the well-being of the community and the national economy.

The problem that faces us today is vastly different from that which existed in the early days of industry. Whereas in those days the major effort was put into the design of the product, the manufacture was left to the man on the shop floor, and the older type of Works Management. This can be readily understood by the fact that materials and labour were plentiful and relatively cheap, but as we are only too well aware, this is not so today, when the rising cost of labour and materials demands of the production side of industry far greater attention than ever before in its history.

FACING THE CHALLENGE

This is a challenge which must be faced. World competition is such that if we, as a nation, are going to maintain our standard of living, if we are going to hold our rightful place amongst the leading nations of the world,

we must be able to produce as cheaply and efficiently as possible. I submit that this responsibility falls very largely on the Production Engineer. If we recognise these facts, I think you must agree that there can be no question of the status of the Production Engineer being of the highest.

Some of the difficulties which we have to take into consideration in assessing the status of the Production Engineer in industry are, the size of the organisation (whether it has 100, 1,000, 2,500 or some 10,000 employees) and also, the type of product which the company is engaged in producing. You can readily appreciate the responsibilities of the Production Engineer of a small concern being vastly different from those which are applicable in a larger organisation.

This is not necessarily because there is any difference in the qualifications and experience of the Production Engineer, but rather because his responsibilities are more limited.

QUALIFICATIONS

We must assume, for discussion purposes, that the Production Engineer has the accepted qualifications, both from the point of view of practical training—which is a fundamental requirement—and also technical training.

We know that the Production Engineer must be up-to-date in regard to developments of Production Engineering technique. He must have drive and tenacity of purpose. He must have personality and qualities of leadership. He must have the ability to put over his point of view, and also be receptive to the ideas of others. He must be trained, and prepared, to accept responsibility. Therefore, for the purpose of expressing my views, I have assumed that these basic requirements exist.

I am not unmindful, however, of the few occasions when one finds the Production Engineer excelling in certain respects, but falling lamentably short in others.

BASIS OF ASSESSMENT

In assessing the status of the Production Engineer I would suggest that this could be reviewed from two possible angles :—

A. The extent of the responsibilities of the Production Engineer, and

B. The executive to whom he is responsible.

Dealing with " A," there are many alternatives in practice, but it would not be going outside the generally accepted terms of reference to say that the Production Engineer is responsible for :—

1. Approval of design drawing for production (by liaison).
2. Preparation of capital expenditure schedules involving purchase of new machine tools, plant and equipment, building or alterations to existing buildings.

3. Process planning or operation sheets, provisional estimated times and class of labour to be employed.
4. Allocation of manufacture—whether to be carried out by the company or by sub-contract.
5. Jigs, fixtures and tools (design and manufacture).
6. Material handling (necessary equipment).
7. Plant lay-out.

Referring to "B" you find many alternatives varying from company to company—but, briefly, in the more progressive companies he may head-up to one of the following executives :—

Production Manager.
Works Manager.
General Manager.
Works Director.
Managing Director.

This does not apply only here in this country but, as I know from experience, even in American organisations.

Having briefly stated the responsibilities of the Production Engineer and the executive to whom he is responsible, I consider it as well to give some thought to the aspects for which he is not directly responsible, e.g., design and performance of the product, Technical Office, Research and Development—this must be the responsibility of the Chief Engineer ; Inspection ; the financial side of the company; Buying functions ; Personnel Office (Industrial Relations) ; all these require their separate control.

How often do we find the Production Engineer or Planning Engineer, or whatever title he is given, only a minor official in an organisation ! This happens very largely in a concern which has expanded but still retains its old form of organisation.

STATUS

In my submission, since the job of engineering production is of such importance—both to the individual company and to the nation—the Production Engineer should be of Director status, so that he is in a position of equality and responsibility when he is submitting his views and recommendations.

At least one very large and successful organisation has its Director of Production, and another very large engineering concern whose name is world-renowned has for its Chairman a Production Engineer, in the highest sense of the term, and perhaps this is an ideal arrangement. There are many more instances known to us all where the Production Engineer is Director holding executive office in his company.

Perhaps we are not prepared to go as far as I have outlined, but there can be no question that the relative status of a Production

Engineer in an organisation, whether large or small, should be equal to that of the Chief Engineer, Works Manager, Purchasing Agent, Commercial Manager, etc.

Generally speaking, whereas in the past the best type of personality and leadership has been attracted to what we used to call the professions, we now have to recognise that the profession of Production Engineering is becoming more evident. In the long run, therefore, the status of a Production Engineer in industry is going to depend on the type and character of the man who is going to study and practice Production Engineering as a profession, and also on his ability to exercise good leadership, so that his rightful place in an organisation is accepted.

You may, on the other hand, disagree with the relatively high importance of his responsibility in an organisation, but this no doubt will come out in the discussion which is to follow.

I will conclude by quoting Dr. Schofield : " I can see no valid reason why the Production Engineer should not enjoy that high place in industry." Whatever may be the status of the Production Engineer, he must be a full member of a team, which is very well expressed in the following quotation : " Men are valuable just in proportion as they are able and willing to work in harmony with other men."

DISCUSSION

Mr. B. H. Dyson (London) said that the paper was allied to Methods of Training for the Engineering of Production. Public and national interest should be encouraged, and industrial leaders should assist in raising the status of Production Engineers. The Institution should constantly strive for the raising of the status.

The Production Engineer should be given the opportunity of exercising his knowledge. In America young bank clerks were taking engineering courses to prepare for entering industry ; this should be encouraged by directors of industry.

Mr. C. H. Fielding (Manchester) stated that two Directors of a well-known engineering firm in the Manchester district were responsible for production in all its aspects.

Mr. G. W. Wright (Western) thought that uplift of status should come from the efforts of Production Engineers themselves. The needs of today's engineering requirements were creating a continued increase of status.

Mr. F. H. Osborne (Manchester) said that the title " Production Engineer " was difficult to establish in smaller engineering firms and was probably comparable with that of Assistant Works Manager. He agreed that every effort should be made to put the Production Engineer on the highest possible level.

DR. H. SCHOFIELD, C.B.E. (Leicester) stated that the long engineering history of this country was contributory to the difficulty of making changes. In many American companies the Production Engineer was a Vice-President of the Company. The Production Engineer should hold a very high standing in a company with a seat on the Board of Directors.

Mr. R. S. BROWN (Western) suggested that the Production Engineer should be consulted at the early stages of design ; this was practice in most progressive companies.

MR. C. R. WHITAKER (London) contended that status was not something which could be put on at will ; it must be earned. He thought that all designers should be trained as Production Engineers ; such a course would help to elevate the status.

Great care should be taken to treat the definition of a Production Engineer most seriously. He had found great difficulty in arriving at a definition. Draughtsmen in Tool D.O.'s, Process and Rate Engineers were tending to call themselves Production Engineers. This should be strongly discouraged.

Every effort should be made to encourage high executives in industry to seek membership.

MR. W. CORE (London) said that the history of the Institution had always shown that the men at the helm had gradually built up the status. The examination now introduced would naturally increase the status.

The young engineer should be given responsibilities very early in his career and should be given the chance of experience on the Sales side, which would increase the importance of the Production Engineer.

MR. D. ALLEN (Birmingham) said that it should be the aim of the I.Prod.E. to prove that all Production Engineers were creators —namely, of efficient production.

MR. T. DOOLEY, M.B.E. (Manchester) stated that there had been nearly thirty years of difficulties in getting the term " Production Engineer " accepted by higher managements. There should be no fear regarding status—this would gradually rise with each succeeding year if the Institution continued with its present progressive policy.

Every encouragement should be given to Students and Graduates to consider the prospects of Production Engineering.

MR. SMITH (Birmingham) allied himself with the previous speaker's remarks. He said that if the Production Engineer fulfilled the requirements of section " A " of responsibilities stated in Mr. Gregory's paper, he would prove his worth to any company and thereby gain status.

In section " B " the title " Technical Director " should be added to the list.

Mr. H. TEASDALE (Western) thought that more interest should be taken in the training of Production Engineering Students. All apprentices should start with a basic training and should be encouraged to specialise at the age of 19-20.

Every effort should be made to obtain a Chair of Production Engineering in Universities, so that a young engineer could by scholarship obtain entrance to this course, and obtain a degree in Production Engineering. (*This suggestion received unanimous approval.*)

MR. T. FRASER, C.B.E. (Manchester) said that the trouble in not gaining recognition in the past was due to bad management. There was also difficulty in getting College apprentices to take up Production Engineering, due to the poor salaries offered ; they all wanted to be Sales or Research Engineers. When this was remedied, no difficulty was experienced in obtaining young men.

Young men in trade apprentice schemes who showed abilities should be encouraged to take up Production Engineering as a career.

The status of the Production Engineer should be at the highest possible level, and all management should be alive to the need for efficient Production Engineers.

Mr. F. G. C. SANDIFORD (Western) said that Production Engineers were responsible for the arrangements for producing. Where was a man going to get the necessary experience ? Only by moving from firm to firm and accumulating knowledge. Mr. Sandiford concluded by asking : " What can the Institution do about this ? "

MR. A. FRASER (Manchester) in summing up, said that it would appear that all present agreed on the following points :—

1. That the status of the Production Engineer should be at the highest level of management.
2. That the training of young men for Production Engineering should be encouraged by every possible means.
3. No effort should be spared in advising young men to take up Production Engineering as a career, and to use every endeavour to encourage them to join the Institution as Students or Graduates.
4. That continued efforts should be made for the establishment of University Courses in Production Engineering.
5. That the Educational policy of the Institution was moving in the right direction.
6. That the policy of status should be constantly in the deliberations of the Council of the Institution.
7. That the senior executives responsible for production in leading companies, who are qualified, should be invited to join the Institution in order to assist in the development of the profession which is so vital to the country's future industrial programme.

DISCUSSION GROUP 'I'

HOW TO USE PRODUCTION ENGINEERING METHODS IN JOBBING AND SMALL BATCH PRODUCTION

by R. B. WILKINSON, A.M.I.Prod.E., Planning Engineer, Bristol Aeroplane Co. Ltd.

Chairman: R. S. BROWN, M.I.Prod.E.
Group Reporter: B. G. L. JACKMAN, A.R.Ae.S., M.I.Prod.E., M.I.I.A.
Rapporteur: A. EUSTACE, A.I.Prod.E.

IT is generally recognised that large scale production is the most fruitful field in which to apply the principles of Production Engineering. Our object today is to consider how far these same principles can be applied in the less homogeneous field of small quantity production, where the number off may vary between one and perhaps twenty or thirty.

In its most concise form the aim of Production Engineering might be said to be the manufacture of the best quality article as efficiently as possible, and in large scale production this is achieved by a combination of the following factors :—

(1) Providing raw material most suitable for a specific purpose, i.e. stampings, die casting, etc.

(2) By installing special purpose machine tools laid out to assist the flow of material.

(3) By giving the maximum assistance to the operator in the form of pre-planned operations, special fixtures and cutting tools, etc.

(4) By introducing an incentive whereby each operator will be encouraged to make the utmost use of the facilities provided.

(5) By employing a system of Production Control.

We will now consider each of these elements in turn to see how far each is applicable to our particular problem.

RAW MATERIAL

Generally speaking, cost is the first consideration in determining the form of material for a particular purpose, and this in turn is largely influenced by the quantity involved. Design considerations or the time factor may, however, override such economic principles, especially in the case of prototype manufacture. One thing is certain, that if a jobbing

shop is to be prepared to make at short notice anything a designer cares to call for, then the material store must represent a considerable capital outlay on which no rapid turnover is possible.

In this connection it is well worth recalling another aspect of Production Engineering, namely, the need for frequent discussion between design and manufacturing teams so that the problems are mutually understood, and any new designs can be tempered by practical considerations at the earliest possible stage.

SPECIAL EQUIPMENT AND PLANT LAYOUT

In the type of department we have in mind it is obviously not possible to install specialised machine tools, but rather the aim should be to have machines which are as versatile as possible so that they can accommodate a large variety of different components. It follows from this that the machining time is likely to be uneconomical by mass production standards.

Likewise, the layout of the department cannot be arranged to give the optimum flow for all components, and the best compromise is to group the machines in types and arrange each group in relation to its neighbours so that it facilitates the general flow of work. Thus, the majority of raw material will probably be issued to the turning section, from where it will proceed to milling, grinding, slotting, drilling, gear cutting, etc. In this connection much can be done to minimise handling by correctly siting the raw material and finished part stores, and by arranging for inspection facilities on each machining section. Similarly, the final inspection should adjoin the finished part stores. Again the goods inwards, raw material, view and material stores should all be closely grouped to minimise handling of material during the receiving stages.

SERVICES TO OPERATORS

The most important and perhaps most controversial factor here is that of planned operations on the one hand, or complete *laissez-faire* on the other. The fully planned method probably causes some initial delay in issuing the work to the shop, but it is doubtful whether this delay is very real, since the shop supervision would have to analyse the sequence of operations and hence would be prevented from attending to their supervisory duties. In addition pre-planning enables points of criticism to be taken up with the Design Dept. at a very early stage, and once a batch is issued manufacture can proceed without receiving special attention from one individual.

A further important factor lies in the ability to call up any jigs and tools that may be required, and to ensure that these are available in time to meet the progress of the components. In this connection the provision of such equipment should be kept to a minimum, and except in those cases where a jig is indispensable the

criterion is, of course, the relative cost of the equipment against the additional cost of manufacture without such assistance. Obviously certain very simple forms of equipment, e.g. stumps, pots, etc., will be required on a large proportion of operations, but these can be left to the discretion of the operator.

Among the advantages resulting from fully planned operations may be mentioned the facility of repeating a batch of work with the certainty of equivalent conditions, the possibility of employing a progress system which can be primarily a clerical function, the introduction of an incentive scheme based on estimated times and above all, the ability to exercise a degree of technical control which is not readily possible by other means. This latter point is most important in the manufacture of precision, heavy duty components, where correct treatments at the appropriate stage are indispensable.

INCENTIVE SCHEMES

Opinions on the value of incentive schemes are probably as divergent as political views, and certainly in a small self-contained section where Tom, Dick and Harry have a thorough knowledge of almost every aspect of the work their pride and craftmanship may achieve more than any external stimulus. As the size of the department grows, however, and with it the complexity of the work, it is manifestly impossible for these conditions to prevail and some form of incentive scheme is highly desirable. Such a scheme must, however, be more complex and less direct than one would expect in a production shop, and because of the inequality of different operations an individual scheme is undesirable. The main principles to aim at in such a scheme may be stated as follows :—

(*a*) A fair and consistent method of estimating.

(*b*) The groups should be kept as small as possible to promote the maximum interest and competition.

(*c*) All elements in the plan should be under the direct control of the participants.

(*d*) Payment under the plan should follow as closely as possible after the event so that real effort and its opposite, each has its immediate and unmistakable reward.

With these factors in mind the following suggestions are made for an incentive scheme suitable for the type of shop we have in mind:

Data required.

(*a*) A nominal time based on ideal conditions is assessed for every reasonable operation. As the conditions are not ideal a contingency factor is added to this time and this corrected figure, known as estimated time, is used for bonus computation. The difference between the nominal time and

actual time per operation expressed as a percentage of the nominal time is known as the excess time, and if this is lower than the contingency factor the bonus is improved and vice versa.

(*b*) A reliable system of investigating excess time where this exceeds the contingency allowance is necessary in conjunction with shop supervision.

(*c*) An accurate return of productive operations completed per week converted into equivalent estimated hours.

(*d*) A knowledge of the clocked hours available per week, making due allowance for work of an unplanned nature.

Given the above data a group bonus scheme can be applied on the basis of the following formula :—

$$\text{Bonus } \% = \frac{\text{Estimated value of productive operations completed, adjusted for variations in excess time.}}{\text{Clocked hours available to producers after making a fixed allowance for unplanned equipment.}} \times 100$$

In this formula the numerator requires further correction to recognise that new starts begin at a disadvantage and improve in efficiency over a given period. Similarly, a fixed correction factor should be applied for all apprentices engaged on productive work.

PRODUCTION CONTROL

We have already seen under the preceding elements that at the one extreme of a small manufacturing unit sufficient information is available from the individuals, and at the other extreme of real mass production the flow from the assembly line is itself sufficient indication of the satisfactory progress of production. The unit we have in mind falls between these two extremes and hence there is a very real need for a satisfactory method of Production Control.

The essential features of such a system are :—

(*a*) In every project the controlling factors can usually be reduced to a relatively few components, and for these a manufacturing float must be established. At the same time if any of the complementary parts for any reason lag behind, then the system must show this in ample time to allow appropriate action to be taken.

(*b*) As it is impossible to compute an accurate forward load on every machine, the method of determining target dates must make some allowance for the inability to forecast

precisely what the position will be at a given date. In practice this means that the number of specially urgent items must be kept to manageable proportions.

(*c*) The method of conveying priority requirements to the supervision must be flexible to allow for changes of programme, scrap, etc.

The following is a broad outline of a system designed to achieve these objectives.

The first essential is to have a reliable basis on which to compute the float period. This can best be established by analysing a series of sample batches manufactured on the basis of receiving absolute priority. By combining this data with a knowledge of the estimated time and number of operations it is possible to establish a graphical relation, from which the float period of any other component proceeding under equivalent priority can be deduced. Similarly, a second scale can be established which will give a float period for any component proceeding on a more normal basis. These two bases can then be applied respectively to the controlling items and complementary parts referred to previously. The system should aim at ensuring that these relative priorities are maintained in relation to the completion date.

In practice a tray type of filing cabinet is probably best suited to the application of this method, each batch having a separate card and a visual indicator to denote the float period required in relation to its priority. All such indicators for a given project should be visible simultaneously, so that the controlling factors are quickly discernible.

The scrutiny of these indicators in relation to the completion date can be the responsibility of knowledgeable progress clerks, and those batches in need of progress attention can be notified to the shop floor progress and confirmed by a suitable indicator on the work card. In order that the system is not abused by the use of an excessive number of priority jobs, the number of corresponding indicators available for attaching to work cards should be restricted to conform to the physical capacity of the shop.

The batch control cards should carry details of all operations, each of which is deleted in turn on receipt of a notification of completion by the medium of a time card. The revised float period is then re-computed from a ready reckoner, and the visual indicator re-set accordingly.

In cases where material is outstanding, the system can be applied to determine the latest possible date by which material must be received if the original completion date is to be met or conversely, the completion date can be readily adjusted in the light of changing material promises.

The system can also be applied to forecasting the date by which special tools will be required for a particular operation, and should thus help to avoid delays due to the non-availability of equipment.

In the preceding discourse it has been assumed that the shop we have in mind should approach as nearly as possible to a full production unit, so that the aims of Production Engineering can be more fully applied. As a result of the degree of pre-planning envisaged, an appreciable volume of additional statistical information is readily available. The analysis of this information enables the trend of departmental activity to be observed, and in some cases appropriate action can be taken well in advance to obviate any particularly undesirable feature arising.

In this talk I have endeavoured to indicate how the principles of Production Engineering might be applied in a shop engaged on small batch production. Obviously the ideas put forward are not intended to be hard and fast requirements, but rather are an indication of what might be achieved under suitable circumstances, and it is hoped that they will assist in promoting an interesting and lively discussion on this subject.

DISCUSSION

Much discussion centred around the use of the Jig Borer, as mentioned in Mr. Wilkinson's paper, as a means of saving time in the manufacture of jigs and tools.

Mr. COOK (Southern) said that the Jig Borer was usually the property of the Tool Room and as such could not be considered a production machine.

Mr. R. E. MILLS (Western) considered there were two classes of small-batch production: the Jobbing Shop and the Experimental Shop. In the Experimental Shop flexibility of the organisation must be such as to be able to cope with constant changes of design, whereas the small Jobbing Shop was not so much troubled by these changes.

Mr. Mills asked how pre-planning and ratefixing could be coped with on small batches.

Mr. WILKINSON said that the organisation must be sufficiently flexible to be able to cope with all these changes, and obviously some form of priority was required.

Mr. R. JENKS (Bombay), thinking of batch production in large quantities, considered that the use of a kit of tools for that particular article should be provided and once the order was completed the tools should be retained for future use.

On the question of gauges, he felt that these must be simple and inexpensive ; and therefore liaison with Production Control and the Shop Foreman was the only way in which this could be achieved.

Mr. J. LOWTHER (Derby) stated that Jig Borers were expensive items which usually could not be afforded by small firms, but generally the design of the article was such as to be within the capacity of ordinary machines.

He went on to query what was meant by "Small Batch Production." He also asked how it was possible to overcome the difficulty experienced in different material sizes.

On the question of ratefixing, Mr. Lowther said that operators usually noted times in their own books, and expected that time in future, irrespective of actual achievement.

The Lecturer, in reply, stated that it was necessary to stock a wide range of materials in order that a variety of new items might be made without undue delay in procuring material. For purposes of estimation, a time was fixed for a particular form of material but if an alternative form was, in fact, used, then an adjustment in the estimated time was made either for a particular batch, or for all batches employing the alternative material.

Mr. GILPIN (Glasgow) disagreed with the incentive bonus scheme. He did not see why it was more difficult to give a correct time on a simple job than on a complicated one. He asked how many people were engaged on ratefixing, planning etc.

Mr. WILKINSON replied that, with a staff of 400 machinists, his Company employed 50 people who did nothing else but Ratefixing, Process Planning and Jig and Tool Design.

Mr. T. W. ELKINGTON (Birmingham) considered that this was dodging the issue, as it was obviously better to tool up for the job properly, especially for quantities of 500 and over. This method was an insurance against scrap and wrong machining, and was generally worth while all round. He contended reasonable tooling was justified in all cases, and that it was wise to spend the money on this in the early stages.

Mr. WILKINSON said that, in his paper, he was not considering batches of 500, but rather 6-10 off.

Mr. GREEN (Manchester) said that aircraft production was not universal and its methods would not work commercially. He considered that it was not possible to assess anything accurately in an aircraft factory, as they were not worried by the amount of scrap caused by the introduction of modifications etc. which the small commercial business would have to consider very carefully. He certainly endorsed the use of a Jig Borer, but the small shops could not afford such a machine.

Colonel C. G. WARREN-BOULTON (Bombay) referred to the use of Jig Borers in India, and said that the number could be counted on one hand and even these were of various types, some of which could be used for ordinary work as well as jig boring. Nevertheless, they were most useful machines. He suggested that the paper

rather implied small batches for later larger production. The paper obviously related labour to industry, but in India there was little loyalty, little pride of craftsmanship, and incentives usually resulted in the man taking time off. Furthermore, it was essential to have some standardisation of raw materials, as India found it impossible to obtain supplies of all the higher grade materials. As an instance, milling cutters were at present being made from several different types of raw material.

On the question of incentives, it was noted that payment should follow closely after the work was done. In India, payment was by the month. Weekly payment would be a help and an incentive. The present method was to give a bonus which usually amounted to two to three months' wages. The position now was that the men expected this bonus, and it was, in fact, taken as part of their pay.

Mr. G. W. WRIGHT (Western) said there were several kinds of Small Batch Production, and obviously the paper had been written and designed to provoke discussion. Some operations could be done on other machines, but they would necessitate the use of a fixture which would cost five to six times as much as the article to be produced. The cost of jigs and tools had risen very sharply, and therefore for work of extreme accuracy, the Jig Borer was not only essential but more economical.

Mr. TURNER (Visitor) considered there were two points of view :

1. that of the Development Shop.
2. that of the Commercial Shop.

In 1, he believed it possible to disregard monetary economics, whereas in 2, this could not be done. Both points of view were fundamentally different, and he thought the speaker was at an obvious disadvantage. His reference to Shadow Bonus Schemes was obviously bad psychology and arrangements of this nature should not be made by back door methods, but openly with the workers. He considered that all jobs could be calculated, whether they were properly tooled up or made by " knife and fork " methods. Past experience would tell the Ratefixer what could or could not be done. He felt it was better to concentrate efforts in the shops rather than in the Planning Department.

Mr. E. FEDDER (London) disagreed with the bonus scheme on Small Batch Production and said that fluctuations, in time, hid the true values of production. He considered that the loyalty amongst workers with a merit award was a far better method of payment. Obviously, workers differed, and the speeds with which they work vary, and he considered that a merit award produced the loyalty to which he had already referred.

Mr. P. H. C. WADDINGTON (Coventry) referred to the varieties of material : he said he was perturbed at the latitude given to

designers and considered that materials could be grouped, which would allow designers to use not only those which were more easily obtainable, but would in fact give them a better quality, and obviate the use of non-standard sizes and materials. In his Company it had been possible, in twelve months, practically to eliminate the use of non-standard materials. On the question of equipment, it had been found very economical to allow the operators to make up small bits of equipment.

Mr. L. R. BEESLY (London) said he wished to make it quite clear that, as far as he was aware, there was no surplus of machine tools, and whilst no doubt Jig Borers were a great asset to production the output of these machines was very small, and he would deprecate any attempt to employ Jig Borers extensively on a production batch.

Mr. GORDON (Birmingham) expressed the opinion that the aircraft industry was not interested in money, but the smaller firms had a different problem. He would like to hear Mr. Wilkinson put forward another paper on the same subject but for the small man, employing 100-150 people where he could not afford the large number of Ratefixers, Jig and Tool Designers etc. which had been mentioned in the paper.

Mr. F. A. MARTIN (Sheffield) said it was an obsession with machine shops to consider mass production. Numbers of books had been written on the subject, all of which were concerned with machine capacity, but they forgot to consider the man who operated the machine. The application of Production Engineering was servicing the man to see that he had all of the ancillaries for the work he had to do. It was necessary to keep the skill on the shop floor where it belonged, as no amount of Production Engineering could take away craftsmanship and skill.

Mr. S. DOWNIE (Sydney) considered there was an even balance between management and engineering. Small Batch Production applied extensively in Australia where the plants made a wide variety of articles. Efficient planning and paperwork were essential for both large and small batch production. Obviously, the number of planners employed must be related to the size of plant and the amount of work to be done. It was very gratifying to hear the discussion on management, which he considered to be of paramount importance.

On the questions of rates and time study, they were at present actively engaged in methods and time study as they felt it was necessary to measure production by time units or some other basis.

Mr. P. B. HIGGINS (Yorkshire) referred to the question of bonus schemes, and considered that the human problem was involved. In group bonus schemes the good workers carried the bad, whereas the merit system caused dissatisfaction. It was necessary to bear

in mind what the general operator could do. He felt that the pride of craftsmanship was being subjugated to bonus rates, and thought it was necessary to help the operator by making things as easy as possible. Mr. Higgins said that a certain amount of tooling was essential in all production, and cited an instance in a Bronze Foundry where it was necessary to do quite a lot of tooling for a small batch of even 50 off.

Mr. J. PARTINGTON (Birmingham) considered that time study could be applied. In a factory of 300 employees only 15 were clerical and they handled 5,000 different operation tickets each week ; prices were pre-printed where available, and it had been found possible to give a price for the job in practically every instance.

Mr. MALLARD (Southern) wished to emphasise that costs and money mattered very much in the aircraft industry. He considered that it was possible to run a bonus scheme on Small Batch Production with an overhead cost of no more than 1¼ per cent.

Mr. J. E. RICHARDSON (Freston) considered that the lecturer had, at the back of his mind, large scale production following the Small Batch Production to which he was referring. He asked whether process planning was really worth while for small batches.

The lecturer replied that, in his opinion, process planning was always worthwhile. Furthermore, incentive schemes made the shop conscious of departmental performance. He appreciated that it was a relatively new idea to introduce Production Engineering into Small Batch Production but it could be done and done economically.

Mr. G. L. BATTY (Manchester) said his experience concerned an engineering shop for a chemical laboratory, and it was very essential to equip the shops with good machines, then educate the operators to use them. They usually think they know all about it, but invariably find that they do not. He considered that a good milling machine would always do all that a Jig Borer could do, by the use of Toolmakers buttons.

Mr. F. B. SCHOFIELD (Preston) disagreed with the group bonus scheme. In his experience he had been dealing with plant for rubber covering of all kinds of equipment. The method adopted had been to carry out a work study on a wide range, and classify them in the various groups. The shop foreman classified the jobs into the various groups and worked on a minutes per square foot basis. If the operator disagreed with the time, he claimed a time study.

Mr. WILKINSON stated that a time study was based on a scientific approach to the problem, and if, after discussion, the time allowed is proved low then a correction is made. Changes in group bonuses were corrected to allow for these alterations.

Mr. M. CARTER (Preston) believed there was a lack of trust of

management and ratefixers by the workers. He considered that it was time for a complete revision of a new incentive scheme where bonus was allocated *en masse* on the completion of a job.

Mr. TAYLOR (Visitor) was of the opinion that the secret of Small Batch Production was in pre-planning, giving due consideration to the tools available. He considered that it was wrong for any job to be issued to the shop floor on a special basis. Each operation should have its stated time.

Mr. J. E. ATTWOOD (Western) thought that, from the discussion, it could be assumed that pre-planning incentives schemes were a fad of management. He felt that, with the present-day shortage, skilled men were far better employed on the machines than sitting in an office working out the best methods. He felt sure it was in the interests of all companies to give some real thought to this question of pre-planning.

Mr. WILKINSON said that the system depended for its success on full co-operation between the workers and management. Times were always available and could be checked if necessary. During three years operation of the scheme he had outlined, the efficiency of the shop had improved considerably, and output was still rising. Furthermore, it was always possible to check the ability of the estimators.

Mr. A. P. RAWKINS (Manchester) said that Method Time Measurement, known as M.T.M., required six months' training. Small shops could not afford this time, therefore they had to compile their own standard data and build it up as they went along. He was certain that the bonus scheme more than paid for itself both in reduction of costs and increase in output. The work must be pre-planned, and the estimators must be trained. He considered that a ratio of 1 : 15 was ample for practically all types of shops.

Mr. H. UNSWORTH (Birmingham) considered that, in the manufacture of small batches, the cost of the article must be a deciding factor in the amount of tools to be provided. It had been found that some small batches could be run in on a section doing large batch production. The method for his firm was to give one man the work of small batches without interfering with the output from the main section. All the men were paid a set fixed wage, but were men of long experience and service with his Company.

Mr. H. C. COOK (Southern) expressed the opinion that engineering owed more to the aircraft industry than to any other for its efforts in clearing away old and obsolete methods. Production was subordinate to the systems employed, but full co-operation between all parties was essential. He felt that the bonus incentive scheme was becoming obsolete and that profit sharing was the new method of incentive, but sound supervision was essential.

Mr. N. A. CULLIN (Leicester) considered that non-financial incentive schemes were by far the best. He was sure that leadership would do much more than money, and pride of achievement was still an essential qualification. As an example, he referred to the team of mechanics working in the pits to maintain a racing car. In his experience dealing with incentive schemes which covered a mixture of financial and non-financial schemes, he was quite certain that the latter were equally as powerful as the former.

Mr. R. S. BROWN, the Chairman, then summed up the meeting, and said that :—

1. The job must be pre-planned.

2. The number of people required for pre-planning depended on the type of work. In some factories 140 operators could be serviced by two Planning Engineers. In other words, 80-90 operators could be handled by one. So far no mention had been made of having a Production Engineer in the Design Office. He felt that a lot of time and money could be saved by giving attention to this fact. A lot had been said about bonus schemes, but at present this was the only yardstick which could be used in Small Batch Production.

On behalf of the meeting, the Chairman thanked Mr. Wilkinson or preparing a very interesting and provocative paper.

DISCUSSION GROUP 'J'

HOW TO ENSURE THE ECONOMIC UTILISATION OF PLANT

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THE outstanding feature of the subject under discussion today is the comprehensive field it covers. It embraces the whole scope of Production Engineering endeavour, and touches all facets of engineering and administration which are normally employed in running an engineering establishment. When faced with a complex problem of this nature, it is wise to reduce it to more simple and manageable proportions, thereby preparing the ground for a systematic investigation of a particular function to which clear and undivided attention can be given. To do otherwise invites confusion and, consequently, wrong decisions.

If this reasoning is applied to the subject title, it is found that it can be divided into four groups which, if arranged in a progressive manner, are as follows :—

(1) Machine Tools (I have chosen to interpret Plant as Machine Tools for the purpose of this discussion).

(2) Their utilisation.

(3) Economic features affecting their utilisation.

(4) How to ensure the economic utilisation of machine tools.

MACHINE TOOLS

It is wrong to suppose that one can buy and install a productive machine tool. The machine may be capable of high productivity, but this will only be realised if it is handled in the proper fashion. Merely to second a skilled and competent operator to a new machine and expect results to follow is unfair to both man and machine. The resulting efficiency will be unquestionably low unless proper supervision and control is exercised under all conditions.

The prime necessity when installing a modern machine tool is to be conscious of its possibilities as a productive unit, to be prepared to procure the necessary equipment to take advantage of those productive qualities and to install the necessary organisation and administration, so that they may be realised. When one is

aware that some general purpose machine tools only cut approximately 20% of their total life, the importance of organisation and administration is apparent.

Manufacturers are convinced that it is profitable to work plant to its capacity, consistent with tool wear and accuracy, so that costs may be reduced and the maximum production obtained from the machine before it is replaced.

Differences of opinion do exist, however, on the question of when a machine should be replaced, but whichever view prevails in this respect a progressive replacement programme is necessary if production is to be maintained at a high level. A fixed sum, however small, should be allocated each year for this purpose, and what is more important, this amount should be conveyed to the Production Engineer whose responsibility it is, at least, to nominate the machine tools most desirable for his purpose. Or should it be the reverse? That the Production Engineer names the sum to his executive which is required to bring the plant up to a maximum efficiency, bearing in mind that this job can only be carried out by men who are abreast of modern trends and development.

This being the character of the machine tool, we must, therefore, examine the conditions necessary fully to utilise it.

UTILISATION

The life of a machine tool is broadly made up of the following phases :—

(*a*) Preparation or set-up.

(*b*) Cutting.

(*c*) Manipulation.

(*d*) Idle time.

The first three phases are required on all jobs, while idle time covers stoppages either unavoidable or otherwise, and its magnitude is generally a reflection of the efficiency of the services required to sustain it in production. To gain the most effective utilisation of a machine is, therefore, to concentrate as great a portion of its life on cutting and endeavour to keep set-up, manipulation and idle time to a minimum. The organisation required for this purpose falls into two categories—Engineering and Administration.

The laying down of production methods for an operation on any job must be carried out by practical engineers who have clearly before them, at all times, their object of ensuring that the maximum metal is removed in the minimum of time, consistent with reasonable wear and ability of the component to pass inspection. Benefit can be derived by consultation with the machine tool manufacturers to this end, or in the case of particular problems reference can be made to the excellent technical research establishments which are available.

There are those, however, who believe that to consult an outside agency is a distinct sign of weakness within their own organisation and seek a remedy in other directions.

Greater controlling factors than the fast removal of metal do arise, but these cases make up a small percentage of the general run of work carried out in a factory.

Having established a cutting time for each job, a sound knowledge of merits of the various aids to manipulation is required. Air-operated chucks and fixtures, hydraulic fixtures, electric chucks and other proprietary types of quick acting devices are available and, by some, considered essential. There is also the T.D.O. and Tool Room whose job it is to produce the products of our own imagination in this respect.

After securing the engineering on a firm basis, the administration is then called upon to provide the essential services. Continuous and regular production must always be our target. To achieve this, the floor to floor time for a job must be closely studied in conjunction with the administrative services provided to sustain it. Expensive machinery standing idle due to a breakdown in some administrative function must be avoided.

There are a number of essentials to be observed in order to keep these breakdowns to a minimum—the systematic oiling of machine tools which, of course, must always be kept clean ; preventative maintenance must be organised ; work requires progressing to and from the machine ; swarf must be removed and lifting facilities made available. The operator must be provided with clear instructions stating what is expected of him ; tools and equipment have to be provided and efficiently serviced during operation. Time lost by an operator seeking every day tools, such as micrometers or holding-down bolts, can never be recovered.

While it may seem desirable to systemise these complementary functions in a large organisation, it may be that in a small plant these duties can be adequately left with the operator himself. If a decision is taken that these duties be maintained by means other than the operator, then the system for doing so must be effective and should become a matter of routine requiring the minimum supervision.

Attention to detail before installation, backed up by active interest and the will that it shall be successful, during service, is the only way in which any system however simple will survive.

ECONOMICS

We now come to the question of economics, which must govern all our engineering activities.

In the broad sense it may well be that a company is said to make economic use of their plant if their products are of a high standard, their selling prices compare favourably with their competitors, and

they make a profit in so doing. This is satisfactory from the accountant's point of view. It is, however, the engineer attending to the detailed economics of each particular job who finally brings this about. To decide whether expensive tooling, conveyors, and a highly organised administration shall be employed, or that some or all of the production functions be applied in a primitive fashion, is a big question.

The bulk of the engineering establishments in this country find that the answer lies between these two extremes, the quantity required in a given period being the greatest single factor affecting the engineering economics. This in turn determines the character of the administration required.

Many complex formulae have been evolved to determine the economic balance of these functions with mathematical precision, but usually the formulae are based on the approximation or assumption of some basic figures. Experience shows that the detailed economics of engineering can never be considered alone. This question has to be considered relative to some fixed circumstances or important factors. Floor space, type of labour, accuracy, ability to procure the right machine, etc., are all features which sway this issue. Even the question of whether a company can face such a financial outlay must be considered. Operations and methods may be introduced which are desirable but quite unproductive and their only strength lies in the fact that they tend to increase the efficiency of some other productive function.

Whatever approach is made to this subject, it is not formulae nor in many cases money which are required, it is judgment. The Production Engineer with his experience and with the full knowledge of the relevant facts pertaining to each particular problem, alone must be the judge, having regard always to the details of company policy as dictated by the higher executive.

It must be borne in mind, always, that practices which have been condemned by one company may well be carried out successfully by another, due to the local prevailing circumstances.

If the economic utilisation of plant could be obtained by mathematical formulae, then truly engineering would be reduced to a common level.

HOW TO ENSURE ECONOMIC UTILISATION

We have touched on various aspects of this subject. We have spoken of working our plant to capacity. Stress has been laid on the attention which must be given to the engineering of production, and how all auxiliary time must be cut down. The systemising of services has been discussed and the ensuring by judgment that all is economically sound.

Having provided the structure, we are faced with two problems,

the first being how to make it work, and the second, how to control it. To make it work we must have good labour relations. This is most important, as system and organisation will come to naught if this is not so. We must provide good conditions if we are to keep our men. To ensure the sound working of our systems and machines it is necessary that all who are concerned are properly briefed and kept fully informed.

When a new type of machine is about to be installed it is wise to have a conference with Foremen, Planning Dept., and Rate Fixing Dept., so that the reasons may be explained for the installation, the type of labour required, type of work expected and generally how the machine will be integrated with existing plant, and how any obstacles regarding services will be overcome. Questions then raised can be resolved.

Regarding systems, the standard written practice must always be compiled and circulated to all concerned. Before being put into practice, the relevant heads of departments should be called together to raise objections and make any modifications deemed necessary. Drive and initiative are then required to see that all systems and machines are fulfilling their appointed tasks.

Secondly, if we are to control our organisation, each function should be so established that a regular check can be taken of performance in a simple fashion against an established standard.

The more important functions should be made the subject of weekly returns. At least two of these weekly returns should be made from any machine shop, the first being waiting time expressed as a percentage of the total man hours available, and the second being the number of pieces scrapped expressed as a percentage of the total number of pieces passed. Some average figures should be provided for comparison purposes. From these two simple returns, it is known whether the shops have been working efficiently and whether the work has been effective.

Standard costing, if used, is an excellent and regular check on production costs, while the system of machine rates throws up the particular overhead charges required for individual machines.

There is no easy way to ensure economic utilisation of plant. It can only be obtained by a combination of all functions, sound in themselves, moulded to suit each particular plant. To be aware of the principles involved is not sufficient—concrete action must be taken to ensure this desirable end.

DISCUSSION

THE CHAIRMAN, in his opening remarks, made the following points :

Utilisation of plant was synonymous with benefit, profit, and

advantageousness, and did not necessarily mean 100 per cent running.

Batch size was of great importance to machine utilisation, but of far greater importance was the general utilisation of other machines, of capital, material and other facilities. Excessive batch size could be highly detrimental.

In the case of valuable machines, it might be more important to develop high machine utilisation rather than to secure cheapest labour cost.

Machine loading could be ascertained and adjusted to the available capacity. The ordinary running time of a machine did not indicate its economic utilisation unless that machine was running at maximum cutting speed. Improvements to machine utilisation could often be obtained through Motion Study.

Mr. GREEN (Manchester) said that to maintain high utilisation in his plant of 1,000 machine tools, 40 people serviced machines and operators with tools and equipment. He asked Mr. Menzies what, in his own factory, was the machine utilisation of automatics, combination lathes, turrets, capstans, mills, drills and presses ; if he could clarify the 20 per cent cutting time of the machine tools ; and if he could estimate the life of a machine costing £3,000, and the number of major overhauls desirable ?

Mr. MENZIES in reply, stated that he had deliberately omitted figures, as to quote without knowledge of factory conditions could give wrong impressions ; however, waiting time would usually give an indication of machine utilisation. In his own plant, where tools were brought to operators, the waiting time in the Heavy Machine Shop was 1.75 per cent. Mr. Menzies stated that considering only floor to floor times and including re-setting, oiling, chip removal and breakdown, etc., the actual machine cutting efficiency would be approximately 20 per cent. Even on new machinery the hand manipulation time was still of prime importance, being in the region of 47 per cent.

Further to Mr. Green's £3,000 machine, this depended entirely on the policy of higher management. They accepted a life of approximately 10 years, then if a better machine and money were available, consideration would be given to purchase.

Mr. J. HARGROVE (Dundee) said it was important that the basis on which machine utilisation was measured should be defined ; was the meaning 168 hours or the operational capacity for all factors met in 44 hours ? Batch quantities requested by Sales Departments often upset production schedules, and he stated that Production Engineers must resist sales demands for 5-off when the economic quantity was 5000-off.

Continuing, he said that the cost of setting was one of the most

important in economic production. Changes should be planned to prevent continual major set-ups. Lastly, preventative maintenance was the key to higher productivity.

Mr. D. H. McCormack (Glasgow) said that electric meter readings were at a peak 2-3 times per day and this was an indication that plant was only fully utilised at these periods.

Mr. W. G. Marsden (London) said that the old machine was not a problem in specialisation when new machines were not used for odd jobs.

Mr. G. R. Burn (London) referring to machine utilisation figures which had been mentioned for the hand manipulation of old and new machines, stated that the important aspect of reduced floor to floor time had not been quoted. On new machines, this would be considerably reduced and if not given could lead to incorrect efficiencies being drawn.

Mr. H. P. Jost (London) stressed the importance of preventative maintenance and the troubles which accrued as the result of faulty or inefficient lubrication. He stated that by ignorance of lubrication, assistance was given in wasting time. Oil, so frequently used, was often not a lubricant, and to establish the correct grade of grease (of which there are very many kinds), and method of application, were of prime importance. The vast majority of breakdowns could be avoided if the correct grade of lubricant was used, and as a result, the efficiency of plant utilisation could be increased.

Mr. A. B. Brown (Edinburgh) stated that so far no mention had been made of materials handling, but the various materials handling aids could considerably increase the efficient utilisation of machines.

Mr. R. Hutcheson (London) said that United States machine tool makers had shown an increase in production of 20 per cent, purely as the result of revising old drawings. He stressed the need for blueprints, issued to the shop, to be easily readable ; the extra time spent in the Drawing Office in making a good tracing, would be well repaid by the resultant savings on the shop floor.

Mr. W. P. Kirkwood (Glasgow) said that there had been no mention of space utilisation which, today, was a most serious factor. He mentioned that if one new machine was introduced, and only worked for half a week but displaced three old machines, it would still be economical on the amount of space released for increased production. However, a small amount of idle time was still more economical than having spare machines idle.

Mr. F. H. Perkins (Glasgow) asked how Mr. Menzies evaluated the machine hour rates on new and old machines, and how he selected his labour for new faster equipment.

Mr. Menzies, in reply, stated that the evaluation of the machine hour rate was an accountant's job and it was unfair to ask the

customer to pay the enhanced rate. This should be spread over the total on-cost of the department and likewise absorbed. Mr. Menzies mentioned that when new equipment was introduced into his plant, it was not necessarily manned by the previous operator, especially if he was an old man. It was unfair to ask people who had been working on old slow equipment to change to faster modern equipment. His policy was to pick the best man for the job, whilst keeping the older men on the machines with which they were familiar.

Skilled men were made conversant with the jobs they were expected to do, by being placed with a skilled operator on the particular job. With unskilled operators, these were selected from a pool of labourers as and when required in the shop. These were initially trained on drilling machines, progressing, as they became more efficient, to feeding semi-automatics, milling machines, etc.

Mr. S. R. TREVILLION (South Essex) said it was his experience during the war that 66 per cent machine utilisation was attainable on multi-spindles ; the remainder being waiting time. He mentioned that the term ' economic utilisation ' was loosely used, but felt that the important factor was more life from each tool.

Mr. ACKLAND said that in his plant of 800 machines, if more than 20 hours was booked in a week due to interference, absent hours, lost time or waiting time, then there was cause for concern. He also mentioned that preventative maintenance was hard to apply in practice when production was being pushed.

Mr. B. G. L. JACKMAN (Birmingham) mentioned that there was need for the right size of material for the job ; cutting off excess material was invariably wasted time. He also mentioned that much more importance should be paid to shift working.

CONFERENCE DINNER

Mrs. Kitson, wife of Major Geoffrey Kitson (*centre*) receives a bouquet from the President of the Institution.

Mr. E. W. Hancock, Dr. H. Schofield, and Dr. Garbett.

Case Study 1

FUEL ECONOMY IN INDUSTRY

by C. F. HURST, Director, Samuel Osborne & Co. Ltd., Sheffield.

Chairman: G. W. WRIGHT, M.I.Prod.E.
Rapporteur: A. EUSTACE, A.I.Prod.E.

THIS question is surely one of the most important responsibilities of all Managers, Engineers, Technicians and Foremen —and never of such paramount importance as today. Generally speaking Production Engineers have been more concerned with the man-hour problem for work than with the efficient use of materials. Perhaps I am not quite fair in saying that ; may I qualify it by saying " service materials " ?

The effort has been rather towards getting the maximum possible output in the minimum possible time—with a view to keeping labour costs low.

EFFICIENT USE OF MATERIALS

Under any circumstances it is wise to pay at least as much attention to the efficient use of materials as to the time/production factor and, in these times of short supply of everything, it is more than ever important to get the highest possible production from the rather scant supplies available especially as shortage of raw materials would seem to be a problem we are to face for many years, as industrial production has increased but raw material production has not.

One exceedingly important raw material in almost every industry is fuel and particularly in my Company's manufacturing activities. In most industries the cost of fuel is a small percentage of total production cost and it has not been considered worth while paying much attention to saving, say, 25 per cent on an item that is only perhaps 2 per cent of total production costs.

Coal, gas and electricity were cheap and plentiful—even within present memory—but to-day continually mounting costs of these three commodities, coupled with reduced allocations and degraded quality of coal, gas cuts and electricity " load shedding " bring fuel efficiency to the forefront of the economic picture.

Perhaps the most important point to consider in regard to fuel is availability as with so many other materials. In some industries quality comes next. Fuel costs are important, but if the fuel is not available and plant has to stop work in consequence, the effects are much more grave and far-reaching than is noticed from an increase in fuel cost.

TACKLING THE PROBLEM

Very broadly there are two ways of tackling this problem of fuel efficiency.

Firstly—and perhaps most important—there is the short term policy which may be subdivided into :—

(*a*) things you can do today ; and

(*b*) things you can do next week.

Secondly there is the long term policy in which I would include all replacements of, or modifications to, fuel-using appliances, that require more than a month to carry out.

Many of the items included in the short term policy can be carried out at no cost and produce surprisingly high returns for the little trouble involved. To quote an actual experience of this—in 1941 we appointed a Fuel Officer, as we considered the question of fuel efficiency was a job for special responsibility. The first thing he noticed was the very considerable excess of air that was used in our gas fired re-heating furnaces. For no cost at all—by merely cutting this air down to something much nearer to a proper balance—a saving was made of about 300,000 cu. ft. of gas per week, at that time roughly £37 per week, the gas usage in the Rolling Mill furnaces being approximately 2,000,000 cu. ft. per week.

In any process involving the burning of fuel, excess air is probably responsible for more loss of efficiency than all other faults together and careful attention to this point can effect an immediate substantial saving of fuel—at no cost.

EFFECTIVE CONSUMPTION OF MATERIALS

In my view the consumption of materials in the most effective manner needs to be dealt with by the best Production Engineering methods and calls for close examination of the work and analysis of the process. As an example of this, the following is of interest. This concerns the hot rolling of Ribbed Thresher Bars.

Previous to 1939 these were rolled in a 14 in. mill of old design, in a plant which had done this work for many years—by the same method. The work was eventually transferred to our main Rolling Mill Department and was carried out in a 12 in. Rod Mill, the old mill being scrapped as obsolete. The old methods of rolling were used, one feature of which was the pointing of the billets by a separate process in our Forge, prior to rolling, as this was always deemed to be essential to facilitate the entry of the billet into the teeth of the roll. In addition to this, black grease was applied to the teeth of the roll while the bar was going through the final pass. This was accepted as standard practice, a boy being employed to apply the grease at each pass.

The process was carefully analysed and it was considered that lubricant and coolant could be fed automatically on to the teeth of the roll, thus applying it to the whole length of the bar during

the final pass and providing a cushion of oil between the roll teeth and the bar. A simple arrangement was made which employed old oil and satisfactorily solved the lubrication problem. It was then felt that the pointing operation could be omitted and that increased output might be attained.

Previous to the change of method, the average output of bars was 180 per shift, approximately 58 cwts. for a fuel cost of about £6 5s. 0d. Following the change of method, the average output per shift rose to 111 cwts. for a fuel cost of £5 17s. 0d., the increase in output being rather more than 90 per cent and the fuel cost reduced by 6½ per cent; a substantial return for a very trifling expenditure.

SHORT AND LONG TERM POLICIES

Another example illustrates the operation of short term policy and longer term policy. This case deals with the operation of two Lancashire boilers 8 ft. 6 in. dia. × 30 ft. long, maximum pressure 100 lb. per sq. inch, capacity 7,500 lbs. steam per hour, serving a Forge of eight steam hammers and occasionally a 12 in. Rod Mill. Forgemen were paid on tonnage and boiler firemen were paid a flat rate. The forgemen frequently complained of lack of steam pressure; arguments arose between forge and boiler firemen and slowing down of production resulted.

The fuel crisis of early 1947 focussed attention on this service. Supplies of coal were not only much reduced in quantity but consisted largely of substitute coal (?) of inferior quality.

We were faced with the alternative of the forge working four days or less per week, as the boilers would not have enough coal for a full week's working, or finding some immediate saving of coal.

BONUSES

It was thought that the offer of an incentive bonus to the boiler firemen to save coal might have the effect of substantially decreasing the boiler coal consumption. A schedule of payments was drawn up, in which payment offered was dependent on relationship between coal burned and steam pressure maintained. Our first suggested scale of payments took coal usage down to 10 tons per day, but the men rejected this as impossible, so the table of payments stopped at 12½ tons per day. The effect was immediate. Prior to commencing the operation of the bonus scheme the average coal burnt per day for the previous twelve months was 14.1 tons. The first ten weeks of the bonus scheme averaged 12.26 tons per day, a saving of 10.12 tons per week. The cost (in bonus) of this scheme was £12 10s. 0d. per week and the *cash* saving in coal was about £28. The great benefit of the scheme,

however, was the fact that it enabled full working time to be maintained and production kept up. This encouraging result led to further investigation by our Fuel Officer and Works Engineer, and the steam service as a whole was reviewed.

SAVING OF COAL

In order to interrupt normal working as little as possible, the job of overhauling the steam service had to be spread over several months, but improvements were appreciated immediately. The work was commenced in April 1949, at which time extra shifts were being worked and the steam driven 12 in. Rod Mill was in much more frequent use and, in consequence, the coal consumption at that period was 13.41 tons per day.

As the work of overhaul progressed between April and September 1949, the daily coal consumption fell to 12.08 tons and, by January 1950 when the overhaul had been completed, the average daily consumption was 8.83 tons. In January 1950 the boiler house staff was reduced from 5 to 3. From January 1950 to July 1950 we were called upon to use 20/24 tons per week of washed slack, supplied as part of our coal allocation. This inferior grade coal represented about 45 per cent of the coal used at boilers and in consequence our average daily consumption increased to 9.73 tons.

USE OF WASHED SLACK

In July 1950 we stopped accepting washed slack (and were that much less on our allocation) and the average daily consumption fell to 7.5 tons, despite the extra load drawing on the steam service.

In November 1950 a trial was made using one boiler only and the coal used fell again to 7.1 tons per day.

In January of this year we were again compelled to add 7/8 tons washed slack weekly to our coal deliveries and consumption rose to 7.6 tons per day.

The difference between the average weekly consumption of 1946/7 and the present time is 38.5 tons per week, almost 50 per cent saving—a cash saving of about £5,750 per year at 1950 coal prices. The production from the forge is now 26.6 per cent higher than in 1946/7.

COAL CONSUMPTION FOR FORGE

Put another way—in 1946/7 we used 1.08 tons of coal to produce the steam we required to forge 1 ton of steel. Today the steam required to forge 1 ton of steel is produced by 0.46 tons of coal. Minor economies have also been made in the operation of the forge re-heating furnaces. In 1946/7 0.46 tons of coal were used for re-heating 1 ton of steel for forging. Today the figure is 0.342 tons (a saving of 108 tons of coal per year). Taking steam and re-heating together, whereas in 1946/7 a ton of steel required 1.54

tons of coal for forging, today that figure is 0.802 tons—a saving of 48 per cent, coupled with 26.6 per cent increase in production. If coal had been used at the 1946/7 rate, for present day output, our coal consumption for the forge (including steam) would be 3,430 tons per year higher than it is (£11,150 at today's coal prices). Incidentally, the expenditure incurred was more than saved in the first year.

To forestall the criticism that these figures may show, namely that we must have been remarkably inefficient previously, I would mention that, at that time, our steam raising and steam utilisation were considered to be comparable to similar plants operating under conditions of poor load factor and point is also given to what must be possible in many plants today.

CO-OPERATION WITH FUEL OFFICER It is essential that if the best results are to be achieved, the closest co-operation should exist between the Works Engineer and the Fuel Officer. The Fuel Officer knows the best way to achieve fuel economy coupled with satisfactory production. The Works Engineer knows the best way to make such schemes practicable and carry an "idea" through the drawingboard stage right on to the workshop floor.

INCREASING OUTPUT In many works there is an amazing indifference to fuel economy. So long as fuel is plentiful and its cost is so small (a percentage of the total production cost of any product) fuel savings are liable to be dismissed as of little importance, but when fuel comes to be in short supply, then fuel economy becomes of great importance in order to avoid reduction in output. In fact outputs can be increased, as shown by the case of two annealing furnaces upon which we made tests, the makers' rated loading of which is 2½ tons each. One furnace, at an average load of 2½ tons, used on average 5,640 cu. ft. of gas per ton annealed. Increasing the load to an average of 4.2 tons lowered the gas consumption per ton to 3,654 cu. ft. The second furnace on loads of 2½ tons averaged 4,620 cu. ft. per ton. Increasing the load to 5 tons lowered gas consumption per ton to 4,113 cu. ft. Taking the two furnaces together, an increase in production of 84 per cent was achieved, coupled with a gas saving of 24.3 per cent.

It is to be noted that the two furnaces referred to are the products of two different furnace builders of great repute, the interesting point being that an overload of 84 per cent on the makers' rating showed a 24 per cent saving and also boosted production by 84 per cent.

FUEL ECONOMY In the national interest, efficient use of fuel is of the utmost importance *all* the time and the call should be not only for greater production of coal from the mines, which merely means consuming our greatest natural asset at a faster rate, but to get everybody more fuel minded so that the constant effort should be to get the greatest possible efficiency out of the coal we use and greater productivity from less of our "bank reserve."

To the nation and to the individual industrialist, the greatest benefit accruing from fuel efficiency is the fact that it enables high production to be maintained on reduced supplies of fuel. Compared with this, the cash saving due to lower fuel consumption, though very acceptable, is of minor importance.

AN IMPORTANT POINT A word of warning is necessary. An important point for Production Engineers to consider is that in having made economies in raw materials, there frequently occurs the annoying factor that, in times of shortage, rations, quotas, etc., are based on consumption even after economies have been made and this can penalise the efficient concern. This must not cause us to relax our efforts, but to demand that efficient organisation must not be penalised in this way. Fuel cuts and load sheddings affect the efficient user as he has no reserve to fall back upon. We have met this in our fuel savings and also in our conservation of alloys in steel making. The cuts are invariably on a percentage of the present consumption basis and take no account of efficiency.

USE OF CORRECT FUELS A further matter which needs our attention is that, in the realms of fuel, our national suppliers have much to learn of the efficient use of the right fuel for the right purpose. Insistence on the use of the fuel which it is considered by the authorities to be most convenient, is not necessarily the most efficient and causes waste, e.g. :—

(1) *Example of the way in which the use of low grade coal decreases efficiency.*

During the six months we were using washed slack on our boilers (January/July, 1950) we used about 570 tons washed slack at a cost of £1,260 and 820 tons singles (£2,442) a total cost of about £3,700.

At the average rate of consumption for the six weeks prior to the using of "slack," the coal consumption for six months would have been 11.75 tons of singles per week at a cost of £3,300—an increased cost of about £8 per week.

Added to the 6 per cent increased cost it is to be noted that during the period that slack was being used, the forge was frequently held up by low steam pressure.

(2) The explanation given by the N.C.B. for their insistence on our using " slack " is that, as our figures show, we can save 350 tons of singles (which are in very short supply) by using 520 tons of slack (of which they have plenty) so that in a year we would save them 700 tons of singles they *do* want, by using 1,040 tons of slack they don't want ! We pay £400 in the year for the privilege of helping them to conserve " singles "—while we also suffer in the way of delays in forging operations.

A METHOD ADOPTED FOR SAVING FUEL

I recently had a report from one of our works as follows :—

Adamson Boiler.

" Some time ago you asked for details of the saving in fuel on the above and method adopted.

" Originally the waste steam from the boiler feed pump was taken out to atmosphere and deposited in the condensate chamber. The waste steam from the pump was not serving any useful purpose.

" We have now fixed a copper coil in the feed tank holding the cold water for the boiler ; the waste steam is then transferred through the coil in the tank and finally into the condensate chamber as before.

" The coil is built up of 1½ in. o/d., 1 in. i/d 10 G copper tubing approximately 50 ft. long in 3 coils in the tank. We have found that, by doing this, we can lift the boiler feed water temperature from 32° F. to approximately 150° to 180° F., thus saving in the vicinity of 2 tons of coal per week.

" We have also found that we can get the boiler up to the required pressure, i.e., 90 lbs. per sq. in., much quicker, thus saving time and fuel first thing in the morning.

" The total cost of the installation during weekend work was £28 material, £38 time. Based on 1½ tons coal saved per week I should say the approximate saving would result in about £5 per week."

ECONOMY INCENTIVES

I should like to make a further reference to incentives for encouraging economy. To give an example on production I might refer to hot sheet rolling and the production of sheets for hand hacksaws.

The allowable tolerance on thickness must not exceed 2/1000 of an inch; bonus is paid on every pound weight of material sold. Inspection is very tight and makes no exceptions.

The first step was to determine a weight of material which experience had shown to be the general average of good production

achieved. For every one per cent of perfect production beyond that average, the operators receive five times the normal rate of payment. Recent achievements have been in the region of 10 per cent over target on yield and payments 50 per cent per man above ordinary rates. The advantages of saving this amount of expensive material from becoming scrap need no stress. The increase in yield has been achieved in spite of doubts as to the possibility of producing any saleable material beyond the past average.

INVESTIGATION INTO METHODS OF CONSERVING OTHER COMMODITIES

I have given examples to show what is possible. I believe similar results can be achieved in respect of other commodities. I know that much economy can be achieved in the use of steels of all types. The correct heat treatment of steels in both structural and tool steel types can provide a field for much investigation to prevent losses which, in many cases, could be avoided. In the use of structural steels, economies can frequently be achieved by changes in design calling for types of steel using less of the alloys in short supply.

I hope I have been able to show the lines upon which investigations can proceed. I would emphasise that change in design, improvements in production methods, and use of alternatives are some of the ways this subject can be dealt with. I do know it is essential for the subject to be approached with enthusiasm in the individual works. There are those who will always resist change and those who do not want to upset the practices they have known for some time. These people must be persuaded to co-operate fully if real success is to be achieved, and real success *can* be achieved.

In conclusion I would add that the recovery and careful segregation of scrap can be of great assistance in this matter. Many people do not realise the importance of keeping different qualities of metals, etc. separated ; in the case of steels much waste and loss of effort results from mixed lots of scrap.

DISCUSSION

Mr. TURNER asked what was included in the term " Overhaul of Boilers."

Mr. C. F. HURST replied that this meant new steam main and each hammer taken in turn, lubricated, valves re-seated etc.

Mr. GREEN (Manchester) asked what type of fuel was being considered and whether any instrumentation was fitted to the boilers. Also were the boilers mechanically stoked with evaporators fitted and instrumentation to show water consumption ?

Mr. J. E. BURNETT (London) mentioned heating by coke; in view of the very high rate of changeover, he had found it difficult to make a decision.

Mr. HURST replying, said that his Company had considered oil fuel but experiments carried out were not very successful, although some firms had been successful. He was unable to comment on the use of coke.

Mr. FOSTER (Chester) said that, in the heavy steel trade, gas furnaces used gas augmented with pulverised coal and oil, but they had now converted to oil on open hearth furnaces. It had not been found possible to effect any economy but, owing to the shortage of coal, they had been forced to make the change. Results were very satisfactory, and they were able to use full instrumentation which was not possible with coal.

The use of a feed water accumulator was most valuable, showing a 280,000 lb. per hour evaporation. The accumulator took care of approximately half an hour's reserve of feed water, and the heat required to turn this to steam was very little. They installed three 1,000 ton oil tanks where the upkeep was very easy and it had removed guesswork which was the operators' slide rule regarding the amount of fuel required.

Mr. TURNER referred to the condition of water in Sheffield, and said that 1/16 coating on feed pipes resulted in a 10 per cent loss of efficiency.

Case Study 2

MATERIALS HANDLING—INTER-PROCESS TRANSFER MECHANISMS

Prepared by a Working Group of the Birmingham Section.

Presented by T. W. ELKINGTON, M.I.Prod.E., Member of Birmingham Section Committee. Director and General Manager, Peter Brasshouse & Co. Ltd., Birmingham.

Chairman: G. W. WRIGHT, M.I.Prod.E.
Rapporteur: A. EUSTACE, A.I.Prod.E.

CASE Studies are the basis of any presentation we may make to industry and before reading the one prepared by the Birmingham Section Working Group, I would point out that I am speaking as one of an active group of members who have been meeting regularly in Birmingham. Also, I must make it clear that I am not a Materials Handling expert—but am just an interested Production Engineer acting as the Chairman, for the time being, of this Group.

FORMATION OF WORK STUDY GROUPS

Just over twelve months ago all Sections were asked to consider the formation of Work Study Groups. Two subjects were suggested :—

(1) Materials Handling.
(2) The Measurement of Productivity.

It was proposed that the Groups should work to present Case Studies ; examples of improvements, and, generally, information that could be of use to industry as a whole.

Our Birmingham Section felt that here was an opportunity for members who were interested to give valuable, practical information towards perhaps the preparation of a Report on British Methods and so add to the Institution's prestige.

It fell to my lot to convene an inaugural meeting, and the appeal made to Midland members brought a ready response. Soon a group of about 18 members was active on Materials Handling.

TERMS OF REFERENCE

Like all new ventures, the first meetings were a little difficult but finally, with the help of our Secretary and other interested persons, we fixed our terms of reference and agreed to confine our investigations to " Inter-Process Transfer Mechanisms." We decided on this subject because we felt that the Midlands offered scope for investigation into the methods of

handling close to or with the operation, rather than handling in the rough or finished stages by the conventional conveyors and fork lift trucks etc.

We felt that some other Section might produce Case Studies on this aspect of Materials Handling, and I think we chose the right subject for, among our members, were many who could be regarded as experts on handling during and between operations.

VISITS TO WORKS

Our meetings were conducted with much enthusiasm and we agreed to try and produce Case Studies from our own Works, etc. To supplement these we had the pleasure of visiting a number of Midland Works where we were cordially received, and it was generally thought that, rather than giving advice, we were all being taught quite a lot about our subject.

Directors, executives and the staffs of these firms spent quite a lot of time and expense helping us in our mission, and it seemed to us all, that here was the Institution at its best, giving and receiving technical information on the " spot."

Our programme became a Works visit each month followed by an evening to report our findings, sometimes asking specialists to come along and read and discuss Case Studies on our subject. We also held many informal meetings in the boardrooms and offices of our hosts, and I think the time was well spent.

BEFORE AND AFTER STUDIES

It was desired, however, to put forward studies on a " before-and-after " basis, giving, wherever possible, actual facts of the savings achieved. This aim proved to be our biggest obstacle, for so many improvements had been made although records of the previous set-ups were not available.

We completed a few studies, and then decided, before going further, to find out whether these were of the right type for Institution use.

AID TO INDUSTRY

Here, gentlemen, is the way to help industry. From first-hand experience our Working Group will support me when I say that all the firms visited thought the scheme worth while, and Case Studies are there and can be brought to light if our members will co-operate.

Our investigations were not confined to engineering alone ; we visited up-to-date layouts and some that are in the throes of change-over, and the Case Study I am going to read, while of a simple nature, will suffice to show the aims of our Group.

This Study was prepared by one of our members, a Consultant Engineer, who has been making improvements in method and layout in the old British trade of pottery.

When you consider that many of the small and medium size factories where his firm is operating have a century or more of trading behind them, you will all agree that any new idea must be carefully prepared and put in plain terms to executives and workers alike. Great strides are being made in this industry and simple ideas, such as those put forward in our Case Study, have paved the way. Our members had the pleasure of seeing the equipment in operation and this visit was a very worthwhile one.

1. This study covers a development in material handling which was introduced at the New Wharf Pottery of Messrs. Wood and Sons, Limited, in co-operation with the Production Efficiency Service of the Board of Trade and, later, Messrs Thackwell and Hayek, Limited, the Pottery Consultants.

2. The aim of this innovation was to replace the existing primitive method of carrying ware between under-glaze decorating and glaze dipping with more modern ones which would effect economies both in labour and floor space, and yet allow considerable flexibility and the carrying of buffer stocks of varying sizes between particular operations within the process.

OLD METHOD

3. The particular process discussed here is the transference of under-glaze prints. In this form of decoration, the patterns are first printed on to paper from copper plate engravings; the paper is then placed, colour inwards, on the surface of the ware to be decorated, rubbed in by hand or mechanical means, in order to transfer the adhesion of the colour from the paper to the ware, and the paper is then removed by washing-off in a tank of water. The means of interprocess handling between the detailed stages described above do not form part of this study; it may be mentioned in passing, however, that hitherto awkward hand methods have been superseded by the use of small belt conveyor units.

4. After washing-off, the colour on the ware is sticky and any direct contact with the decorated part of the surface must be avoided otherwise smudging will spoil the pattern. The method of handling ware from this stage to the next differs with its shape. In the case of flat items (e.g., plates, dishes, etc.) distance pieces of varying shapes, known as "stilts" or "bits," are used, and the items are then put one on top of the other. In view of these distance pieces, it is not safe to stack the ware higher than 18-30 pieces. In the case of cups, holloware and "fancies," items are placed on "potter's boards," which are ordinary hardwood boards $\frac{3}{4}$ in. to 1 in. thick and usually 5 ft. or 6 ft. long and 9 in. or 1 ft. wide.

5. Many of the items are stacked 2 or 3 rows high and something like 140 to 200 pieces can be accommodated per board. Filled

boards are picked up with both hands and carried on the shoulder supported by the up-turned palm of one hand. Buffer stocks, on the boards, are stored in stillages consisting of tubular steel or wooden sections supporting both ends of each board.

6. It need not be stressed that the methods described above are extremely cumbersome and expensive both in material and labour. Whilst it is true to say that the potter acquires great skill in the handling of boards—even on narrow staircases and other obstructions—the loss is still quite high ; ware does fall off or get knocked off, particularly from the rear end of the board. Another consideration is the operator working space required to handle boards, furthermore, good pottery boards are surprisingly expensive—about 15/- each.

NEW METHOD 7. In devising a more suitable method of handling decorated pottery, the following factors had to be borne in mind :—

(*a*) The new medium had to be flexible enough to allow for the accommodation of varying shapes and sizes of pottery-ware without loss of space in any combination.

(*b*) The new medium had to allow for the separation of ware with " sticky " printing colours.

(*c*) Sub-units of storage had to be small and handy enough to be manipulated by a girl operator. The unit as a whole, on the other hand, had to be large enough to make it economical to move, yet not too large so as to avoid overloading of floors or lifts.

(*d*) The unit had to be suitable as a medium for self-contained buffer stock storage and for the simpler task of inter-process handling.

(*e*) The unit had to be reasonably cheap.

8. After numerous experiments, a 4 ft. 0 in. × 2 ft. 0 in. pottery stillage of welded angle iron construction with wooden trays, and movable by a Collis or Yale type lift truck, was evolved and it was found that it met all the requirements set out above. Storage arrangements within the stillage are flexible : there are angle runners at $3\frac{1}{2}$ in. intervals (7 in. intervals in some cases) which are taken up to support trays or missed, according to the height of the ware to be accommodated.

It will be seen that this also allows for effective separation of ware " sticky " with printing colours.

9. Furthermore, storage sub-units are small and handy, consisting of simple wooden trays, 2 ft. 0 in. × 2 ft. 0 in., which are easy

to manipulate in and out of the stillage itself; with 42 cups or a similar number of pieces of flatware (in bungs 6 to 9 high with " bits " in between) the total weight per tray is reasonable for a girl operator. The unit as a whole is compact—4 ft. 0 in. × 2 ft. 0 in. × 57 in. high, accommodating up to 32 trays in 2 parallel columns of 16 each, yet its total weight is never more than 4-5 cwt. and usually much less. Thus the system can be used in old buildings with a floor loading of only 75 lbs. per square foot.

10. The large amount of ware which can be accommodated in a small space makes this stillage eminently suitable where buffer stocks are essential. Compare an average of 80 dozen per stillage, i.e. 120 pieces per square foot floor space, with the old-fashioned static stillage accommodating boards where, at best, two-thirds of that number can be stored.

11. Stillages so far manufactured have worked out at a cost of £6 5s. 0d. each, plus rather less than £5 0s. 0d. for trays, a total of £11 0s. 0d. each. In addition there is the cost of the lifting truck at about £40 0s. 0d. per truck. The number of stillages which can be moved by one truck varies, but 60-75 can be taken as an indication for this type of usage, thus the cost of lift truck per stillage works out at less than 15/- each: therefore, for the average capacity of 80 dozens per stillage, capital cost works out at 3/- per dozen handling capacity. This is less than with the old-fashioned board where the cost is about 1/6d. per dozen on the same basis, but the " life " is less than half of that of the stillage set-up.

12. The major direct saving comes from the reduction in the cost in handling. Previous to the installation of these stillages the department employed four boys purely on handling ware between the processes described, in addition to which the operators themselves had to do a fair amount of ware carrying. The department now employs one trucker only whose wages can be roughly offset against the time spent in handling by operators themselves. Thus the nett saving is four boys at, say, 45/- per week each, i.e. £9 0s. 0d. per week or £450 0s. 0d. per annum.

In addition there is an indirect saving which is less apparent but at least as important, i.e. the increase of effective production area, in this particular case amounting to approximately 20 per cent.

FURTHER DEVELOPMENTS

13. The success obtained with this method of mobile stillages led to a number of further applications which are, however, outside the scope of this Case Study.

Before closing, I would mention that other completed Case Studies are :

(*a*) The conversion of a single spindle automatic machine to countersink the reverse side of a tubing nut to avoid a secondary operation. This has been accomplished by an ingenious arrangement of air-operated pick-up fingers and feeds and, as the production is very high, considerable savings have been effected although the initial cost was £200.

(*b*) Automatic feeding and operation of a standard drilling machine to countersink a bicycle dynamo part ; also by a complete air-installation with standard parts.

(*c*) The adaptation of a rolling mill in order to bring back to the operator, after it has passed through the rolls, by means of an automatic pick-up and an overhead return conveyor.

These studies are available for members' inspection.

These, gentlemen, are the type of studies we have been seeking, and I think that our members could supplement them by passing on studies from their own experiences, with their Companies' permission of course.

We have heard so much during this Conference of the need for interchanging ; this is the way we can not only help our members but the country and industry in general.

DISCUSSION

Mr. R. KIRCHNER (London) said that the London Section was very willing to co-operate in these Case Studies and suggested that, if the two Sections got together on this subject of Materials Handling, a lot could be done for the small firms, whilst the Institution as a whole could do a big job of work for the companies with 100 employees and over.

Mr. H. BURKE (Birmingham) said that he gave wholehearted support Mr. Elkington's work, and mentioned that the committee concerned with the re-organisation of the Institution had been considering this question of help for the small firms. It was felt that in its widest aspect it was rather outside the scope of the Institution, but nevertheless special aspects, such as Materials Handling, could be considered and it might be possible to arrange a National Committee in the form of a co-ordinating body.

Mr. J. E. ATTWOOD (Western) said he had long been a supporter of help for the smaller companies but there appeared to be a reluctance on their part not only to help themselves, but also to accept help from the larger companies.

Mr. T. W. ELKINGTON said that some large firms used very cheap equipment which could be made up quite easily. All inter-process handling in the case put forward was by gravity feed. In presenting this Case Study, companies visited had received them very well, and they were being asked to visit more firms than they could possibly manage. He felt sure this was the real way to get Production Engineering into industry. The group should consist of about 18 members and each one should take a particular case and spend twelve months studying it.

Mr. L. HOLT (Wolverhampton) remarked that, in his opinion, Materials Handling was akin to motion study, but there was a tendency to use conveyors wastefully. Operators could be merged with advantage ; whilst the use of simple chutes could save space, time and money.

Mr. R. E. LEAKEY (London) stated that, in his view, 90 per cent of the large firms were really a number of small firms in a large building. Production Engineers' efforts these days were concentrated on using part-time labour, and the techniques in use must be adjusted to suit the available labour.

Case Study 3

CONTROL METHODS OF PLANT UTILISATION

by Professor J. R. IMMER, M.Sc., B.A., A.I.Prod.E.

Chairman: G. W. WRIGHT, M.I.Prod.E.
Rapporteur: A. EUSTACE, A.I.Prod.E.

PROFESSOR IMMER commenced by saying that this was a very wide subject. There was a danger of emphasising the equation ; measuring plant utilisation against actual output. There were some overheads to contend with, therefore they must be measured and controlled. Building utilisation concerned the amount of cubic space occupied, i.e., considered as square footage to which was added height. Some warehouses had doubled their capacity without altering the building. As an example, Professor Immer mentioned 4,000 lb. rolls of sandpaper ; lack of storage space forced the Company concerned to store it seven miles away from the factory, which involved a lot of transport. After consideration it was put on an overhead monorail conveyor, with fork trucks. They were thus able to store all their stock in one building. He emphasised that the area used for storage counts equally as much as that used for production, and pointed out that other plants in Chicago have stored all material overhead.

On the question of handling equipment, Professor Immer said that considerable use had been made of fork trucks, but it was important to co-ordinate their use to avoid wastage. Some large factories were using the radio telephone ; some, two-way radio, and the very latest addition was control by television.

He then mentioned the utilisation of machines, and said that it was essential to eliminate non-cutting time, and to work out more efficient co-ordination among machines and operations : to plot them on a graph and introduce a visible element into the control device.

DISCUSSION

Mr. J. E. BURNETT (London) said that he agreed with the improvement of output, but considered it was also necessary to increase sales. Some firms had spent large sums of money on new plant, but, on investigation, their sales did not justify the cost.

Professor IMMER replied that, in his opinion, the Production Engineer could not have been doing his job otherwise he would have analysed the position before buying his new machines.

Mr. TURNER thought that these were all calculable factors which could be measured and should be observed. The moulding machine was one of the most inefficient machines in use to-day. In France the problem had been tackled in an efficient manner, and they had now increased the output of moulds per day with the same labour force.

Mr. L. HOLT (Wolverhampton) agreed with Mr. Turner as the handling time was not taken into account by the Jig and Tool Designer.

Professor IMMER suggested that the Production Engineer should be on speaking terms with the machine operators.

Mr. H. FOSTER (Sheffield) said that space utilisation in blast furnaces required special consideration. Space was very limited and after a careful detailed investigation they had been able to overcome their difficulties, maintain their output and reduce their labour.

Mr. G. W. WRIGHT, the Chairman, gave a brief summing up of the various case studies put forward, and proposed a very hearty vote of thanks to all the speakers.

Third Plenary Session, 30th June, 1951.

DISCUSSION GROUP REPORTS

THE Third Plenary Session of the Conference was held at the Royal Hall, Harrogate, on Saturday, 30th June, at 9-15 a.m. Mr. Walter C. Puckey, Chairman of Council of the Institution, occupied the chair.

The CHAIRMAN said that he was glad to see a number of ladies present. He could only assume (a) that they had no money left, or (b) that they were curious about the enthusiasm which their husbands had been displaying for meeting in the Royal Hall.

During the last two days, many gems of wisdom had been falling from many lips, and it was the task of the distinguished gentlemen on his left and right—their position had no political significance—to make them into something of a necklace and present them to the meeting. Those gems were not artificial pearls, and the task of the four speakers that morning would be to decide what to leave out, not what to put in.

Looking at them, he was reminded of the story of the Red Indian maiden—if there were any Red Indian maidens present, he apologised in advance—who suddenly left her father, who was the chief. One of the young braves disappeared at the same time. Some time later, the old chief was sitting in his wigwam when the flap opened, and in walked his daughter, complete with a baby. Nothing was said for a few moments, and then she raised her hand and said " How ? " He was silent for a while, and then grunted and said " Me know how. Who ? "

When he looked at the gentlemen on either side of him, he was in the same predicament. He must say Who, and he had some difficulty in deciding just How he should introduce them. After giving the matter some thought, he decided to introduce them in the order shown in the programme.

The first speaker would be Mr. E. W. Hancock, M.B.E. He was very well-known to most of the members ; he was a Past Chairman of Council and a Vice-President of the Institution, a member of the Coventry Section Committee and had been instrumental in forming and actively concerned with many of the Committees of the Institution. He was Director and General Manager of Humber Ltd.

Mr. Jackman was a Member of Council, a member of the Finance and General Purposes Committee, a member of the Special Committee on Reorganisation, and Works Director of the British Heat Resisting Glass Company Ltd.

Mr. Seaman was a member of the Education Committee and of the Research Committee, a Past Member of Council, and General Manager of the British Oxygen Company Ltd.

Mr. Stuchbery was a Member of Council, retiring Chairman of the Technical and Publications Committee, a member of the Finance and General Purposes Committee and of the Research Committee, and Chief Technical Engineer of The Metal Box Company Ltd.

A photograph of Manchester and Sheffield members taken during the Harrogate Conference. Included are D. G. Brown, J. R. Widdowson, J. H. Hartley, H. Handforth, T. Holmes. H. Taylor. and E. Levesley.

Courtesy of "Machine Shop Magazine"

REPORT ON

DISCUSSION GROUPS A, B & C

by E. W. HANCOCK, M.B.E.

" How " is the theme of this Conference, " How to facilitate the introduction of improved methods into industry." It is my privilege to give a brief report on three of the papers and the discussions which followed them. The title of the first paper was "How can Production Engineering Methods ensure the most Effective Use of Materials ? " The second was " The Importance of Materials Handling Methods, including External Transportation," and the third " How to create Greater Productivity by Simplification of Design." These three subjects took five and a half hours of the time of about 100 people, so you will appreciate that in the time available to me it is difficult to do more than make a very brief report and a few general observations.

APPLICATION AND INTRODUCTION

The theme of the whole Conference presupposes—and rightly so, in my opinion—the existence of improved methods, and the problem is, as usual, one of application and introduction. Tradition, apathy, finance and facilities all contribute to the problem of application and introduction, but each in turn, in my opinion, is capable of solution. Such a Conference as this, with the opportunities for broad reference and detailed discussion, should help to dispel apathy and to change tradition.

On the subject of finance, I would give one word of advice. I feel that the British Production Engineer has a long way to go in learning how to present his case. It is not sufficient merely to extol the technical virtues of an improved method ; it is particularly necessary to emphasise the economy, based on competently assessed facts and calculations, and also the period of financial recovery as against the old method. Technical enthusiasts will never win against cold-blooded accountants. Also, in the expenditure of sanctioned moneys a broader understanding of the whole project is required, and the appropriate allocation of money within the project needs a wider study by the Production Engineer. It is often easier to obtain sanction for a machine tool than for material handling equipment, but in my opinion this depends entirely on the way in which the case is presented. The same applies to the introduction of more modern methods of production having a fundamental background, such as the extension of the upset forging

process, the waste wax method of casting, the sintering process, hot coining and so on, as these processes go a long way towards the elimination of the more expensive process of machining.

These points all came out in our discussions. To my mind, a machine tool with a 100-h.p. motor creating swarf at the rate of so many cubic inches a minute is the modern sign of inefficiency. If we are to ensure the most effective use of materials, I submit that the basic objective of Production Engineers should be, by the introduction of modern methods, to plan on the principle of the minimum loss in weight between the original raw material and the finished article.

EFFECTIVE USE OF MATERIALS

Turning more specifically to the points raised in the Discussion Sessions, the first study, as I have said, was " How can Production Engineering Methods ensure the Most Effective Use of Materials ? " Mr. Widdowson in his paper, relating chiefly to steel production, first emphasised the need of his industry for scrap material and called our attention to the fact that the word " scrap " is a misnomer ; scrap, he said, is a valuable raw material. As I see it, so long as the scrap has been honestly come by—by which I mean that you do not go out of your way to make this valuable raw material—we must all support Mr. Widdowson. He appeals to all Production Engineers to give more attention to the segregation and collection of scrap.

He refers also to tungsten, and calls attention to alternatives and substitutes. He also refers to the general shortages of these semi-precious materials. He makes an appeal for the greater use of tipped tools to minimise the use of tungsten. He calls for a very much closer review by Production Engineers of the tooling problems, as he believes that by study and a steady effort 12 per cent tungsten tools can be used instead of 18 per cent. Another reference which he makes is to sulphuric acid, and he gives examples of how this can be recovered and waste avoided, while by the adoption of improved de-scaling processes a saving can be brought about.

The final part of his paper deals with fuel economy, and he strongly advises a close study leading to an educational scheme, and gives a list of useful pointers for all concerned to follow. These suggestions were divided into three groups, advice to (a) managers, (b) supervisory staff, and (c) operators. He concludes with five points : (i) the starting or heating-up period of any plant should be as short as possible ; (ii) careful arrangements for the programming of work should be made ; (iii) furnaces and boilers should be adequately sealed during standing periods ; (iv) weekly consumption records should be kept of all fuel consumption units ; and (v) trials and tests of all equipment should be made periodically by the appropriate technical staff.

When the " whistle blew " for the discussion—it was very much like a Rugby match—the ball went straight into the scrum and was heeled straight out ; we kept right away from the steel side to start with, but we came back every now and then to steel, because it was regarded as an important material. It was a most enthusiastic discussion which the Chairman permitted to broaden out, but what is important is that nobody went outside the theme of the Conference, thus showing that the subjects which we had chosen were all completely interrelated.

NEED FOR TECHNICAL DEMOCRACY

That brought out the next point. We found the inter-relatability in this particular subject of all the various functions in industry, and we discovered once more this Conference theme of " How," and the " How " came back to the human factor, and how best to get points across to all the people concerned. I shall say more about that later, because it ran right through the whole discussion. I coined a phrase which seemed to catch on, i.e. the need for greater " technical democracy " in place of " technical isolation." I found that in these discussions there was great " technical democracy."

Many ways were mooted of how reclaiming processes could be introduced in these times of shortage. Take high-speed steel grinding ; the mud—usually thrown away—could be sifted out, and the residue from the sludge could be reclaimed. Again, the ultimate sludge left after whizzing the oil suds could be burned for space heating also.

There were various suggestions for using waste heat. A very important appeal was made for better systems of stock control ; we say that we are short of material, but very many of us do not really know what we are holding. Someone threw out the suggestion that we should make more use of the rain that falls from heaven ; we get enough of it, but far too much goes down the drain and we use far too much electricity pumping it back again. There were many suggestions for the elimination of waste.

MATERIALS HANDLING METHODS

The next paper was on " The Importance of Materials Handling Methods, including External Transportation." Mr. Hiorns, in presenting his paper, covered the wider aspects of the application of materials handling and made an appeal to Production Engineers to assess their expected economies by studying the relative cost of material handling as against the cost of processing, machining and assembly.

Quite apart from handling materials within the factory, there is a much wider study to be made right from the first point of handling from the suppliers to the first point of usage by the ultimate customer. Mr. Hiorns indicates in this connection that there is much room

for breaking down this problem as a result of individual study, and he points out that there is not only a direct economy by improved handling methods but also a subsequent and larger economy in maintaining the flow of production. To emphasise this point, let me quote a paragraph from his paper : " It is amazing in this so-called mechanical age that we engineers have neglected the problems of efficient utilisation of vehicle capacity and the speedy turn-round of vehicles at loading and unloading decks." He quotes time studies on this question, comparing old-fashioned methods with the new methods by which the work of unloading can be carried out in one-twelfth of the time previously required. He further urges that in the original planning of a layout (quite apart from the various processes), plans should be made whereby all unnecessary handling of materials is eliminated.

He indicates also that there are certain fundamental principles in connection with this subject which can be applied to all industries. I agree that probably improved methods under this heading can be as widely applied as any other single investigation in this country. Mr. Hiorns speaks also with up-to-date knowledge of American practices, and strongly advocates the creation of a Materials Handling Engineer as a staff unit in the scheme of things. He concludes his paper by indicating that this subject is bound up with the effective utilisation of productive man-power, and the elimination of unnecessary effort by the use of more modern mechanical means of material movement.

In my opinion, it is most appropriate that this subject should be discussed at this stage, as here is a typical example of known improved methods which require the closest possible study in regard to application. Quite apart from questions of apathy and tradition, however, there is the most important question of finance. These new methods do involve very heavy capital expenditure, even in order to improve facilities for despatch and receiving, and often require modifications to existing buildings.

MASS AND BATCH PRODUCTION

Here again discussion went straight off on " the sound of the whistle," and whenever a speaker sat down at least two people rose. It was a very good discussion. There was a little argument as to who had the easier job, those who were dealing with so-called mass production or those dealing with so-called batch production. Each side felt that they had all the troubles, but running right through it could be seen the opportunity for this problem to be solved. I was very delighted to find that somebody spoke of tobacco, somebody else of soap, and so on, and at least we managed to get away from the machine tool and

making motor cars. The wide basis of the discussion was very impressive. Swarf handling was one of the points raised, and again the turn-round of lorries was emphasised.

To me, however, the great question was again " How "—how to get it over. There were many examples quoted where there was still great difficulty in getting this point across, indicating the need once again for general consultation and the getting together of the people concerned. It seemed that there was a job here for our trade union speaker, Mr. Lincoln Evans, and I thought that he could come in and settle one of these problems, because it was nothing to do with the technical advantages. It is beyond question that this study of materials handling should help to get away from the old " coolie " method of carrying two-hundredweight sacks on the back and develop towards a more scientific method of materials movement, and this study offers one of the biggest savings and one of the best improved methods which we can introduce into industry to-day, and I hope that it will stay for all time.

STANDARDISATION AND SIMPLIFICATION

The third subject was " The Increase of Productivity by Standardisation and Simplification." Here Mr. Lister made a most useful contribution to the Conference theme. He endeavoured to couple together simplification and standardisation. He appeals for simplification in regard to the range of our finished products, and indicates that the application of standard details within a range can still give variety to satisfy the customer market. He refers to the simplification of component design, so as in the first place to give the Production Engineer an opportunity for economic production. He then calls the same attention to raw materials and the simplification of the size ranges required. In the production shops he indicates an opportunity for simplification and standardisation of jigs and fixture details, so that from the points of view of maintenance and cost there is the elimination of unnecessary varieties. He makes the same reference in regard to machine tools and to various production processes.

He rightly calls attention to the fact that these points are mainly the prerogative of the Production Engineer, who should have more influence on these subjects. He defines simplification as being commercial and selective, and technical standardisation as being to establish in use the best design, quality, method or process for performing a desired function. He calls attention to the various international groups responsible for standardisation, and indicates that considerable work has been and is being carried out along the lines referred to. He also refers to the national and international specifications which have been compiled over the years.

CLASSIFICATION OF STANDARDS

He refers to the classification by Mr. Woodbridge, of B.S.I., into five main groups, as follows: (i) standards of fitness for purpose and performance; (ii) dimensional standards; (iii) standard methods of sampling and testing; (iv) standard terms, definitions and symbols; and (v) standard codes of practice. He indicates that if industry's attention is continually focussed on these five guiding principles, this leads to simplification, with its resultant economies and improvements. He quotes as an example a list of 140 different standard sizes of silver steel up to 1¼-inch diameter, and points out that in four or five instances the size increments are 0.0006 inch, and that there are numerous instances of increments within 0.0015 inch.

He makes a final appeal for a stronger lead to be given to the industry standards and technical committees by augmenting their staffs, but without seriously affecting the system of voluntary agreement.

Although the meeting at which this was discussed was held in the evening after dinner, again the discussion went straight to the mark, and there were just as many people present in the evening as there had been in the morning. Considerable support was expressed on the question of simplification, and as an example of what industry is doing in this connection the motor car industry was quoted, where the "Big Six," as they are called, who represent the largest percentage of the production of the trade, regularly get together, and have done so for eighteen months or more, to try to get down to a basic simplification of their designs. I quote that as one example of which I am aware, and in the discussion which followed it was obvious that there was a considerable amount of agreement with this commonsense approach, and attention was called to the obvious things which we should be doing at any time, and particularly now.

There was one reference made which I should like to repeat, because I think it is very important—to be most careful, as Production Engineers, to keep our eyes on the main point. It is our job and our duty and our satisfaction to be able to produce economically and to the required degree of finish all the wonderful designs which emanate from our designers in this country. We must not, in my considered opinion, allow our views to trammel the activity and scope of our designers. I hope that we shall strike a balance between standardisation and flexibility, with common sense thrown in for good measure, so that we do not allow standardisation of our thoughts, because if so we are sunk. This point was well discussed, and I am sure that even the advocates of standardisation would not put it in any other way than that it has to be introduced and applied with common sense.

Once more we found this variety of human activities all coming into this question; once more we found the need for up and down and horizontal personal discussion in order to solve a problem. Our old friend the screw-thread turned up, of course. You have all heard about that, and the subject is so thread-bare that it does not require any more comment from me.

In dealing with these discussions it is easy to tell you what was said but more difficult to give you the spirit behind it. However, I shall try. There was an unbounded enthusiasm, and that is a fine sign. If we are keen and enthusiastic we shall find a way of doing things. I was delighted to see a number of the younger men at these meetings and I hope that they get all that they can out of this Conference.

IMPORTANCE OF CO-OPERATION

The second thing which stuck out more than anything else was the fact that no one thing, no one person, no one unit, no one function did anything at all, and that they were all completely interrelated one with the other. The Conference theme, people getting together, conferring together in a democratic and free atmosphere to solve their mutual problems, was very evident, and I sincerely trust that that will be carried back to our industries and to our factories.

Do not be afraid of talking to the Designer, and let the Designer not be afraid of talking to the Production Engineer, but *talk early enough*—that is a point which was brought out very forcibly—the time to talk is when the problem is in a flexible condition, and the influence of everybody can be brought to bear to achieve the best results in the shortest time. If we have anything to learn from America it is the wisdom of this practice to get together and talk early, so that all feel a party to a scheme and that all have made their contribution to it. I think that we in this country are still inclined to remain in our little isolated sections and to say " It is nothing to do with you—*yet*." Let us break that down. That is the point which came out of each of these discussions.

The common denominator of these three discussions was the human factor. Every time we asked " How" we were concerned with the human factor. This question of application always came back to this, and it came out in all the discussions. There can be no doubt that this emphasis on *how* we are to get these points across is probably the most valuable thing which came out of all our discussions.

One suggestion I would like to make is in regard to the Anglo-American Productivity Teams, that if, as stated by previous

speakers, one of the objects of these Teams is for the "ordinary man" in the U.S.A. to know the "ordinary man" in Great Britain, then I suggest that there should be an opportunity for these Teams to take their wives, as my experience indicates that this is the best way to learn how another country LIVES, as against the present Productivity Teams ascertaining how they WORK.

REPORT ON

DISCUSSION GROUPS D, E & F

by M. SEAMAN, M.Sc.

The first of the papers on which I have to report was presented by Mr. F. H. Perkins on " How to Introduce and Apply Methods of Training for the Engineering of Production." Mr. Perkins defined training for engineering production as being concerned with two main streams of production executives and craftsmen, going towards the functional specialist at every possible level on the one hand, and on the other hand towards the management executive who was concerned with a production unit in all its aspects.

He drew for us a valuable diagram which showed that there were two main streams which could give rise to the Production Engineer exercising his function at various levels, one coming from craft and works training allied to part-time technical instruction in all the necessary subjects, and the other and parallel one coming from training at higher levels in universities and higher technological institutions, with a somewhat similar shop background. It is important to understand this, because in Mr. Perkins's view these two streams meet at a point where a degree of Production Engineering training is necessary in order to convert those coming up by both streams into men competent to carry out their work at the higher levels.

POST-GRADUATE COURSES

That brought up the subject of post-graduate courses in engineering training, using " post-graduate " not as an academic term but with a very down-to-earth, shop-floor meaning, in that most people will need a post-graduate works training to add to their past experience the full range of knowledge and experience necessary for the higher appointments and the use of their knowledge at different levels.

The paper brought out the main facts of the case, and attention was drawn to the very leading part which the Institution of Production Engineers has taken in applying the stimulus necessary to produce an intelligently-conceived situation in this field of education, both within firms and within the universities and technical colleges. A great deal depends on the way in which the Institution, together with its industrial partners, deals with the definition of this problem and sees to it that the right solutions are found.

Attention was drawn to the growth in the number of Higher National Certificates in Production Engineering and to the improved position in this respect, but the relation between the

numbers of such certificates and of those in Mechanical Engineering was observed, and the conclusion was drawn that we have a very long way to go in order to obtain a correct balance.

U.S. TRAINING METHODS

Our American friends referred in the discussion to the effect of the action taken by industrial leaders and institutions in America, in ensuring that a very high ratio of expenditure and performance was devoted by educational institutions to the training of production executives, and it was pointed out that when Edward Sloan gave five million dollars to the Massachusetts Institute of Technology for application to Industrial and Production Engineering the subject gained an enormous impetus, and the same results would be obtained over here. Our Institution has made a very good start but, with its industrial partners, it has a long way to go on this subject to make it the really powerful force which is so necessary in our country at the present time.

A great deal of attention was given to the small firm. It is recognised that while larger firms may have greater opportunities to arrange for training, when you come down to a unit of perhaps 200 or less, covering 85 per cent of the firms of this country, you have a very difficult problem in the training of Production Engineers. In order to provide training for executives who can ultimately take charge of such small firms, a plea was made for a degree in engineering which should include a very large component of Production Engineering, a B.Sc. or B.E. in Production Engineering. Such a trained executive, it was suggested, would be the sort of man who at a very early stage would be able, with the addition of suitable works training, to deal with the problems of a small firm. That seems to me to be a powerful argument for that kind of specialisation, if indeed it may be termed a specialisation at all.

EMPHASIS ON CRAFTSMANSHIP

Craftsmanship, as a part of the full theme, was given attention, and it was noted that very many trade associations, institutions and firms are rightly emphasising this type of training, and that it is one component of the whole picture which deserves continued and very special attention, since the necessary ratio of skilled men increases with the greater formulation of planned methods of production.

Attention was directed to a point which I think still requires some investigation, and on which our American friends were able to express very helpful views. If we examine the numbers of those taking higher technical training we find that most of them in the engineering field are taking mechanical, electrical or civil engineering courses, and yet more than 60 per cent of them will finally

emerge as managers, administrators and Production Engineers, for whom unquestionably Production Engineering training is of great importance.

There was some support for the suggestion that in the organisation of our technological institutions there are two fundamental courses, a course in Production Engineering and a course in Chemical Engineering. Analysis will show that their curricula are complementary. It is probably true that on that basis a logical development would be to have specialisation in electrical, mechanical or chemical engineering, with a 4-year course leading to a first-class honours degree.

A word should be said about the post-graduate aspect of the matter, and here again I would emphasise that I am not using that as an academic term, but as a shop-floor term, meaning the training at a high level of people who have to appreciate the full and wide field of Production Engineering. When a young man enters industry he may require training in Production Engineering as a preparation for his future activity, and there may be specialists who at different levels will require a period of Production Engineering training in the works. Useful work has been done in this field, and we all agree that some concentration on it is necessary in the future.

THE PROBLEM OF LATE ENTRY

Another point which was raised and which is of considerable relevance is that of late entry, where special training is important in the Production Engineering field. All of us will have observed first-rate leaders, craftsmen who have the endurance and drive necessary for production executives and who have emerged on the shop floor, and foremen who, owing to the usual hazards of life, have perhaps neglected some part of their specific technical training. There is room in these cases for special training in production technology for men who undoubtedly have the ability to achieve the highest positions in our particular field.

Real leadership has been shown by this Institution in this subject, which is one of tremendous importance. I know of no field of education which is more important, and on my own behalf and as arising from what was said at this Discussion Group meeting I would recommend that we give the greatest possible attention to it in the future.

MEASUREMENT OF PRODUCTIVITY

The next paper on which I have to report was concerned with the subject of " How to Measure Productivity by Statistical Methods." This was remarkable for the cunning with which various people dealt with it. Professor Mundel, who has been soaked in the statistical side,

decided to give it a good " brush-off," which he did by giving us paper in which the important points were laid down as guides, and he virtually said " From there on, brother, you are on your own." He quoted to us a production handbook which had 96 factors concerned with statistical measures, and he said that he could think of another 30, so that we were in no doubt about the precision of the treatment which he was prepared to give the matter in any long-term discussion.

The detail of statistical method varies enormously, and it is therefore necessary to bring out the chief points with which it is concerned. The subject being " How to Measure Productivity by Statistical Methods," taking Mr. Hancock's definition that this is a " How " Conference, we have to satisfy ourselves that we know what we want to do. The minutiæ of accuracy are beside the point. One can go into arithmetical detail *ad nauseam*, but it will not get you anywhere unless you know what it is all about, and the " How " of statistical methods must be decided on the basis of whether you know what you want to do with them.

STATISTICAL METHODS

It was brought out that the first object is to enable decisions of an intelligent kind to be made at all levels, and to make that a basis for the definition of goals and the promotion of action which will lead towards those goals. There is nothing static about statistical methods. This is very important, because it will in many cases condition the basis of the use and application of statistical methods. For instance, even the word " statistics " alone, or even more the introduction of any idea of the theory of probability, may ruin any sound application of statistics in a firm if they are not used with due care.

It was agreed that there ought to be a framework of statistics, charts and all the usual aids, expressed in simple terms, so as to lead to effective action, and it is surprising how much you can do when you try. The perils of comparison were shown by detailed examples. The particular form of measurement adopted and its application in management is very often a domestic affair, and it may be wasteful to make comparisons with anything outside. Comparisons are useful only where elements of precision can be introduced of which there is considerable understanding.

There is also the question of the use of the output of information at all levels. The point about any statistical methods is that they round off the equipment of any supervisor or executive. A knowledge of the facts, decisions and goals is necessary. It was recognised that if there is a full understanding of the facts which will give opportunity for action, then in that field statistical measurements and methods have had their full play. Examples were put forward of statistical controls applied to very large firms, and the

point was brought out that statistics, or the measure of industrial performance, were vital to the large organisation, where such figures and charts are indicators of the health of the body which one is viewing and provide the basis of technical and managerial action.

It was agreed that statistical techniques could be very wide and varied, but that the information which they provided to aid management was what was important. It was agreed by everybody that the subject must be approached with a very high and indestructible sense of humour.

THE RIGHT INCENTIVE SCHEME

Our evening paper, after a long day, had the advantage of having as its author a very pungent personality in Mr. R. W. Mann, who kept us wide awake and very well amused. The subject was " How to Choose the Right Incentive Scheme," and, as was fitting, the Institution of Production Engineers gave it a very down-to-earth treatment ; any high-flown theoretical assumptions were very rapidly brought to earth. Men and circumstances were realised to differ very much. That is most important, because, of course, the field is just as wide as the whole of human effort put together ; it is the widest subject of all, the use of money and other incentives to give the highest levels of production together with the highest quality.

Mr. Mann's paper was in the nature of a direct case study of a particular organisation which represented many of the primary principles. When I had the job of summing up, it at first appeared, in the light of all that had been said during the preceding two hours, to be quite impossible ; but I succeeded in assuming that there was a measure of agreement and, having known Production Engineers and managers for many years, I have the conviction that what I am going to say represents the identity of views at which they arrived.

The first point is that, in any incentive scheme, management must know with precision exactly what it is trying to do, as it is inevitably going to be the key operator, the trigger switch, in the whole scheme.

Knowing what it is trying to do, the next necessity is some form of measurement, a measurement which will give fairness and economic soundness. This subject of measurement proved to be quite as varied as the previous field of statistical method ; it varied from " horse trading " in rate fixing to the very highest flights of measurement of the various components. We had two very different versions of it. A distinguished managing director laid down the theorem that in setting a time the right procedure was to let the operator time him. The operator was then very sure

about the acceptance of times and the standard set. On reflection, there can be no question of the soundness of that approach to the matter. On the other hand, we were given a view in which bonus schemes as such simply disappear ; you pay a straight rate based on an efficient factory. We had recounted to us by a distinguished executive the actual circumstances of what all of us must know to be a very effective application of that principle.

The common deduction which we can draw, and which was fairly drawn, was that in both cases the management was applying the most rigid works study to itself directly. Where the managing director did the operation on the shop floor the point is obvious. It is equally obvious that in the highly-integrated organisation, where a very complete preparatory works study and process study is carried out, exactly the same operation is done with much the same ruthlessness.

USE OF WORKS STUDY

The third point of agreement is that no incentive schemes are the slightest use without first-rate methods of works study and unless the procedure allows for continuous variation with good will on both sides. Any method is out of date the next day, and the changes in the standards applying to incentives in putting a new method forward must be acceptable, and the situation must be fluid on both sides.

A striking point is that in this meeting there was a wide use of detail, supported with enthusiastic fervour, but the principles on which it was all based in each particular case have a common value. They are simple in many cases, but their simplicity is a measure of their importance.

REPORT ON

DISCUSSION GROUPS G & H

by A. L. STUCHBERY.

Our Chairman gave us certain allotted times, but he did not make it very clear whether we had a collective or individual bonus if we performed our task in less than the allotted time. I shall attempt to earn the bonus, even if I do not get it.

The first thing which impressed me was the enthusiasm with which all these Groups attacked their problems, and it is a privilege to report on two of them. The first dealt with the subject of "How to Apply in Industry the Knowledge gained from Production Engineering Research." The meeting was very well attended, and Mr. Kirkwood opened the proceedings with an excellent paper.

APPLICATION MORE IMPORTANT THAN RESEARCH

First of all, he underlined the fact that we were dealing with application rather than with research itself, and he advanced the view that application is probably considerably more important than research, since research is a means to an end whereas the application is an end in itself. Running all through the discussion emphasis was laid on the fact that, while there may not be as much research in the purely Production Engineering field as we might wish, there is a tremendous amount of information which is not being applied, and that therefore this emphasis on application is a very proper one. However, it is obviously impossible to apply something which does not exist.

Mr. Kirkwood divided the work on research into three general groups : (i) the work of research associations ; (ii) the work of research departments in large organisations ; and (iii) the research which is the outcome of a normal organisation in doing its ordinary job of work. In considering these three, he pointed out that the information available from (i) is likely to be available to members only, while in the case of (ii) he felt that lack of publication, and perhaps reluctance on the part of organisations to publish, would preclude the information being available except in a limited sense, so that in effect the opportunities for applying a great part of the information will largely be found in the third group, particularly if we can find some mechanism by which there will be a greater exchange of information on the part of those who are ordinarily engaged in doing the job.

EXCHANGE OF IDEAS

A good deal of time was spent in the discussion on this basic question of the exchange of ideas, and I think that it is fair to say that we can do as much harm by over-simplifying that problem as we can by making it over-complicated. It is not true that you can simply fling open the doors of industry on this or the other side of the Atlantic, as we all know. It is obviously not sensible to make premature disclosures, even to those who are closest to you, and certainly you would not seek out your competitor and disclose what you intend to do in the future. But this surely is an extreme and a wealth of opportunity for exchange exists before this danger arises.

One point which was brought out which was extremely apt was the case of a man concerned with the cutting of gears of 6 to 10 inches in diameter who had learnt something very valuable from seeing a combined operation of de-burring at the same time as hobbing in cutting gears for clocks. No harm can be done to either party by exchanges of that kind, and I am sure that we have all seen many examples of where an exchange between two people in completely different industries has had remarkable and beneficial effects.

In that connection, Mr. Nurrish, the Chairman of the Group, drew attention to a war-time experience which he had had, where it was desired to extend more widely a development which had been found to be of considerable value. Notwithstanding the fact that operatives were brought in and trained and temporary supervision provided, in a very short space of time the value of that was lost in many of the factories to which it was applied, largely because of ill-advised modification, or even because of the belief that certain precautions had been taken unnecessarily and therefore could be dispensed with. I think that the point there is that if we are going to apply these things we need to know them thoroughly and to know exactly what is intended. We must not make " slap-happy " modifications and assume that the man who was responsible for the development did not know what he was about.

Mr. Nurrish also emphasised the need for caution in regard to the exchange of ideas, and that we must not necessarily assume that either one extreme or the other should be adopted. It is generally true that a leader in any field is unlikely to be passed by mere disclosure of what a visitor can take away.

UNIVERSITIES AS SOURCE OF RESEARCH

In the discussion which followed, it was pointed out that the universities had not been mentioned as a source of research. Mr. Kirkwood indicated that that omission had been largely deliberate, because of the paucity of work on Production Engineering which is coming out of the universities. There did not seem to be entire

agreement on this point, though the balance of opinion was in favour of that view. Dr. Schofield pointed out that the endowment of universities in the United States is a very powerful reason for the closer contact which exists over there between industry and the universities, and he mentioned an endowment by General Motors to the extent of some six million dollars, and the fact that such an endowment very readily leads to a certain programme being undertaken.

Certain members of the Discussion Group remarked that the highly-desirable idea of sending university graduates back for work after they had had considerable experience in industry did not always work in the way that we should like it to, and it had sometimes been found by doing that, that instead of getting good men for industry, we were merely creating some more professors.

Mr. Shilton mentioned his interest in the university approach at Leeds, and indicated that a search for work on materials and purely Production Engineering matters was disappointing, but it is encouraging to know that it is hoped in that University to undertake certain fundamental work in regard to the Production Engineering aspects of grinding. Other speakers, however, felt that it was not altogether true to say that the universities were not doing the work, but that the trouble was that the contact between the industry and the universities was not strong enough to extract it from them, and see that it was made available for the benefit of industry. It costs a great deal of money, even if industry does not directly pay for it.

NECESSITY OF HARMONIOUS OUTLOOK

It was also suggested that research was a heavenly story with no earthly meaning. I think that behind that phrase there is the necessity for harmony of outlook between the people who are carrying out research and the people who apply it. Mention was made, for instance, of a certain snobbery which sometimes exists on the part of people carrying out research, who like from time to time, perhaps not altogether deliberately, to speak a little over the heads of the people who have to use it. That is very unhelpful. It is very much better to secure this community of interest, so as to enlist the support of the man who is applying research. It is reasonable to say, since the Institution has such an interest in the activities of P.E.R.A., and particularly in the past had so great an interest in that organisation, that I personally have been very pleased to observe the care which P.E.R.A. take to see that their reports are understandable at any level. I know that their reports are read and re-read to see that no criticism of the kind to which I have referred can be levelled against them.

Reference was also made to the technical press. The technical

press take the view that all too frequently they have to do the spade work of digging out the information. They claim that we in industry have a great deal of information which they sometimes come to our works and dig out, and which we have not even codified and made intelligible even to ourselves, and that when they have done that we do not allow them to publish it. There is probably something in that, and I think that perhaps the Institution could do something about it.

Mention was also made of the National Physical Laboratory. One of our friends from Yorkshire said, " It is too bad that if you want anything done by the National Physical Laboratory they charge you for it and, as we pay for it in taxes anyway, we do not like to pay for it twice." However, it is better to pay twice and get delivery once, than to pay once and not get delivery at all.

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THE INSTITUTION'S UNIQUE OPPORTUNITY

On this question of application, the Institution of Production Engineers has, in my view, a unique opportunity, as distinct from the more normal opportunities which exist for research. The main opportunity seems to me to be that, industries apart, and rather along the lines of functions, we ought to be able to get different groups of people with kindred experience, and with no sort of competitive difficulties, to bring together their experience. I am thinking now of experience in getting a job done from top to bottom, whether it is the purely technical approach of the application of a particular tool to a particular process or the whole gamut of organisation from top to bottom. The Institution is in a unique position to achieve that object. Mr. Nurrish, in opening the discussion, said that he felt that the appointment of an Institution Technical Officer would go a long way on these lines, and I believe that we as members must back that up, but we must realise that we must do more, because it is not reasonable to expect that one Technical Officer can cover all the ground covered by this Institution.

Charles Lamb was once heard to say, " How I hate that man ! " A friend remarked, " I did not know you knew him," to which Lamb replied, " Of course I don't know him. If I did, how could I hate him ? " There is a lot in that, between research and application.

STATUS OF THE PRODUCTION ENGINEER

The other subject on which I have to report is " The Status of the Production Engineer in Industry." This was a small Group, and I think it very proper that it should be. I was encouraged to see that the only people present were elderly people who could not possibly be interested personally ; they were people who had been interested in it to my knowledge for a matter of twenty or thirty years. They

are the people who have built up this Institution, and they were there because they were interested in status objectively and not personally. I think you will be pleased that that was so.

Mr. T. Fraser took the chair, and you all know that he has done more work, and worked more consistently and over a longer period, than many other members of our Institution. Mr. Gregory presented the paper, and divided the matter into two main headings : (i) qualifications, which was a question of technical and practical qualifications, and (ii) drive, personality and personal qualifications of that kind. He said that one could assess status by what the Production Engineer was responsible for and to whom he was responsible.

I cannot deal with this subject at any length or I shall lose my bonus, but the general view was that, if possible, the Production Engineer should be of director level, mainly to ensure that there should be a logical and continual development of production ideas. The idea that the status should be at director level appeared to me to have no relation to titles at all ; it was purely concerned with the practical application of principles and with seeing that they were continuously applied.

ESSENTIAL QUALITIES

The discussion emphasised that, as professional status depends essentially on the type and character of men, and as Mr. Gregory ended up by emphasising the essential quality of leadership, we have to bear that aspect of the matter in mind. I could not help reminding myself of the modern advice of the Old Lady who lived in a Shoe ; she said that when she had trouble with one child she gave it medicine, but when she had trouble with them all she took it herself. There is no doubt, of course, that the status of the Production Engineer is going to depend very largely on the standard which we set academically and in training and so on, from the purely technical point of view, but there are other aspects which require consideration.

Mr. Dyson, for instance, pointed out the need for everybody to see that a personal recognition of the dignity of industry is inculcated among the people who have to make a choice of whether to go in for one of the other professions, such as the law, or to apply their abilities to industry. That is not a serious problem to-day, but I am sure that most of you will have had experience of the fact that this question of dignity has often had the effect of directing, in the past, very capable people into wrong channels.

Emphasis was also laid on the fact that there must be a national status and, throughout the general background of the discussion, we were concerned with the fact that authority must match responsibility, and that people must be prepared to accept responsibility and all that it implies. That took us back to what the Archbishop

of York told us. We have to realise that the growth of this sense of responsibility takes time, that the Institution itself has grown in that way over a period of years, and that probably there is a great deal on which we can look back with satisfaction, but without complacency, so far as the growth of the status of the Institution is concerned.

OUTCOME OF BAD MANAGEMENT

Mr. Fraser, in summing up, said he felt that much of the difficulty had arisen from bad management in the past. In the early days the fight had been against bad conditions, bad pay and so on for Production Engineers, and he felt that, as those conditions had been corrected, so the picture had changed. I think that that is sound. Behind the discussion I sensed a realisation of the very serious aspect of moral obligations, without which no status given by technical ability can ever really be sustained, and I felt that we could really go back to those very simple words, " By their works ye shall know them." If they do a good job they have no need to worry about status, because it will not be denied.

I have heard it said that a successful man is one who can earn more money than his wife can spend, and that a successful woman is one who can get such a man. I think it is true that a successful Production Engineer is one who can save more in doing his job than the general average trend demands, and that the successful industry is the industry which gets such men. If we apply ourselves along those lines, bearing in mind this background of moral obligation, the question of status can be left to take care of itself. Let us remember that morality, when vigorously alive, sees further than intellect, and that the man whose word is his bond is in the long run going to be more valuable to us than the man who is technically superlatively good, but of whom we do not quite know how he will use the word " expendiency."

Let me end with a word about this Institution. When a body of men band themselves together and call themselves an Institution, I think that the status of both the body and the individuals is equal to the lesser of those two. Let us not forget that the status of the Institution will be no better than we as individuals make it, and let us also remember that, if we let the Institution down, it lets us down, and if the Institution does not live up to its opportunities it lets down the entire profession.

I am sure that all the members who attended the two Groups on which I have reported were immensely impressed by what took place, as I was, and it gives me great pleasure to present these brief reports.

REPORT ON

DISCUSSION GROUPS I & J

by B. G. L. JACKMAN.

The first Group on which I am reporting discussed a talk by Mr. R. B. Wilkinson on "How to Use Production Engineering Methods in Jobbing and Small Batch Production." We had an attendance of nearly a hundred and a most interesting meeting. Mr. Wilkinson outlined some of the main principles derived from quantity production which he considered applicable to jobbing production, and I will enumerate these :—

(1) To provide material in the most suitable form for a specific purpose.

(2) To have versatile machines—here we have a slight difference from the quantity production outlook—which can be turned over to various types of work.

(3) To pre-plan operations so that the maximum of assistance is given to the operators, and no lost time results from their having to sort things out for themselves.

(4) The introduction of a suitable incentive scheme.

(5) A suitable system of production control, including forward loading of machines and sections, priority determinations, material supply dates and flow of materials.

MEANING OF BATCH PRODUCTION

The paper was very brief, and the thanks of the meeting are due to Mr. Wilkinson for allowing so much time for discussion. As soon as the discussion started, I realised that we were in for trouble ; small batch production means so many different things in various parts of the country. In the eyes of Mr. Wilkinson it meant prototype production of quantities of 1 to 6 and possibly 12 to 25 off, while to many of my Birmingham colleagues it meant quantities of 500 to 10,000 off. For some time questions and answers flew backwards and forwards and we were to some extent at cross-purposes. Eventually the Bristol members explained the set-up of the organisation about which Mr. Wilkinson was talking, and we got down to some basic considerations and conclusions.

The first was that flow principles should be observed in a jobbing shop in the siting of raw material stores, finished parts stores and so on, having regard obviously to the grouping of the machines.

Secondly, an essential factor about which there was unanimity was that a varying degree of pre-planning should be applied to every single component going into the shop.

Thirdly, jigs and fixtures should be provided in almost every case, particularly where quantities were more than 12 off. These jigs and fixtures need not be at all complex, and many in due course would become standard equipment, but because they were standard equipment there was no reason to leave them lying about the shop, neither should every operator have his own particular little pet fixture leading to unnecessary duplication; all fixtures should be stored and numbered in the normal way.

It was also agreed that full co-operation from the design office in achieving a suitable design for production is necessary. Mr. Hancock says that we should leave the Designers alone to finish their designs but contact them at an early stage in prototype production. I wonder whether the Designers can perhaps come a little in our direction and look at the Production problems before design is completely finalised.

It was also agreed that some indirect labour was absolutely essential in a jobbing shop—planners, rate-fixers, progress clerks and so on. The number may be as small as 1 to every 100 machine operators, or it may be as high as 10 per cent ; in the Bristol case 40 to 50 people were servicing a shop of 400. The point is that you have to have these people to ensure the efficient running of the shop and to eliminate waste and lost time.

Finally some suitable form of incentive scheme must be present. Opinion was very sharply divided on the merits and demerits of a group or an individual bonus scheme. We always seemed to hit this problem whatever Discussion Group we attended, and in this case I feel that we overlapped the Group which particularly focussed its attention on this point. In trying to adjudicate fairly between all opinions expressed, it would appear that a combination of merit rating for the skilled craftsman, who can be left alone to do a good job of work with the knowledge that he will give value for money, and a group scheme applicable to all members of the department, including the progress people and planners, is desirable. That, I think, will probably overcome some of the troubles of the two separate systems.

RATING SYSTEMS AND INCENTIVES

Coming now from principles to more detailed consideration of one or two problems, one speaker emphasised that as soon as you start a merit rating system and give two or three good men a little more, in a very short time the whole shop has to have it. That is a problem which has to be faced, but I think that this hybrid scheme is probably the only answer. One speaker referred to the value of non-financial incentives. He emphasised—and I agree with him—the fundamental value of leadership in the undertaking and pride of achievement,

and gave it as his considered opinion that this was equally as important as, if not more important than, actual money. Colonel Warren-Boulton, on the other hand, spoke of the difficulties in India, where if you let people earn more money by a group incentive scheme they do not turn up ; they earn their 200 rupees or so which is sufficient for their immediate needs, and then you do not see them for the rest of the month.

Another interesting point of detail was the rather revolutionary idea of using jig borers as production machines. Mr. Wilkinson apparently does this a good deal, and for quantities of 1, 2 or 3 off, it is understandable, but I was surprised to hear of it being done for 25 and 50 off. One speaker urged that it should not be done, on the ground that there were not enough jig borers in the country in any case.

Finally, can I say once again to Mr. Wilkinson, thank you for a stimulating and provocative paper on this most important subject.

UTILISATION OF PLANT

The second paper was entitled " How to Ensure the Economic Utilisation of Plant," by Mr. J. Menzies, who gave us a clear and forthright picture of the principles to be observed. It was fortunate from my point of view that I was chosen to report on these two groups, because they link up so well.

Mr. Menzies made it clear that he was talking about machine tools when referring to plant. We got on to other items of plant in the discussion, but initially we thought in terms of machine tools. He emphasised how wrong it was to buy an expensive machine and expect good utilisation with a poor operator, or without a full explanation being given to the operator ; it was unfair to the man and to the machine. He advocated, as a cardinal principle, obtaining all the necessary equipment to go with the machine tool, to ensure that full advantage could be taken of its capabilities. He recommended that fixed sums should be available for the regular replacement of plant. This is quite a normal procedure, but he approached it from the point of view of the Production Engineer telling his executive exactly what he needed to spend every year in order to keep his plant efficient and up to date. That is a somewhat different approach from the normal one, where there is a financial control system in operation and you decide first of all that you can spend a certain sum on the replacement of plant, and where, by the time it gets to the Production Engineer, the amount has probably been whittled considerably, and he is expected to work miracles with that.

On utilisation, Mr. Menzies said that in his experience many machines were cutting for only about 20 per cent of their total

time. This figure was challenged in the discussion, but it emphasises the need for the maximum cutting time on any unit, and the minimum in setting up, idle time and so on. To this end, production aids such as electric jigs and hydraulic or air-operated fixtures should be used to the optimum extent. Another essential point in achieving economic utilisation is a good system of production control giving continuous and steady production, avoiding peaks and depressions, and getting a measure of balance into the organisation.

Another factor, and a most important one, is imagination and plenty of it in the tool drawing office and the tool room, particularly in ensuring minimum handling and the maximum effective operation time. Other points dealt with were cleanliness, preventive maintenance, lubrication and good servicing of the operator in regard to tools and so on.

THE ECONOMIC FACTOR

In dealing with the economics of the matter, we were on less tangible ground. As Mr. Menzies said, formulae do exist to determine the economics of plant utilisation, but it is seldom that any particular formula can be applied to a particular plant. The quantity in the batch required at any time is the greatest single controlling factor, and this eliminates the use of a formula unless you derive it over a period of years for yourself. Allied to this question of batch quantity, judgment is necessary to ensure a completely balanced and efficient integration of the whole activity. Where this exists the economics are bound to be fairly sound, even if not perfect. Labour also comes into it ; the contentedness of the people doing the job, their skill and the effort that they put in all play a major part on the question of economics. You have to know your men, keep close to them, and have " shirt-sleeve collaboration," as we heard from Mr. Walter only yesterday, on the introduction of new machines and equipment with all the people affected and not just the foremen or technicians.

Those, briefly, are the details brought out by Mr. Menzies in his paper. Inevitably in the discussion there were people who wanted facts and figures. Mr. Menzies, I think rightly, kept off actual figures of percentages of utilisation, because they mean so many different things in so many different types of plant. One or two figures referred to in the discussion, however, are worth mentioning. I was a little worried by the fact that the experience of the members present seemed to show that the total utilisation of total possible working time varied from 66 per cent to 78 per cent, and I did not feel that that was high enough. One figure which cheered me up was Mr. Menzies's own figure, the result of several years of hard work and statistics of only 1.75 per cent idle time on

his machines. By " idle time " we mean the actual time when the machine should be working and is not, after allowing for all other factors such as setting up time and so on. I thought that that was a good figure, and in the discussion it was borne out by many speakers, who reckoned that their own figure was about 2 per cent.

COMPARISON BETWEEN OLD AND NEW

Another interesting detail was a comparison made by Mr. Menzies, in answer to a question, between an old and a new machine tool doing the same job. On the old one manipulation time was 46 per cent of the total cycle time and cutting time 54 per cent, while on the new one manipulation was 48 per cent and cutting time 52 per cent. That is an important fact which we have to consider in our new designs of machine tools, so as to ensure that we get the optimum amount of actual cutting time.

So much for the details. The summary of the whole spirit of the discussion is covered by eight points, which I will enumerate :—

(1) The machine must be cutting or doing useful work for the maximum amount of time, not just running for 70 per cent of the working week, but cutting and producing articles.

(2) The labour controlling the machine must be present for the maximum amount of time, not walking round the shop looking for tools or talking to other operators.

(3) The fullest possible consideration must be given to batch size and to the form of the material to be used for the job in order to reduce or eliminate excess metal and the time necessary to remove it.

(4) There should be a comprehensive and rigid system of preventive maintenance and cleanliness.

(5) Much more attention than is normally given should be paid to lubrication, and not only to frequency of lubrication but to ensuring that the right type of lubricant is used in the right place. I should like to ask our machine tool friends why we do not have more automatic lubrication. I am not a machine tool man and I may be ignorant of possible developments in this direction, but if a fairly well known make of car has managed to have automatic chassis lubrication for many years quite successfully, it should not be a difficult problem to have the same sort of operation on some of the more normal forms of machine tools.

(6) Consideration should be given wherever possible to the introduction of shift working. I realise that labour supply creates difficulties in this respect but, coming as I do from an industry which works seven days a week, 24 hours a day, I am appalled when I hear that a large proportion of our industry still works only a

normal day shift week. I cannot believe that 44-50 hours per week is sufficient work for a machine tool or any other expensive plant to be doing.

(7) You should lead your men, keep close to them, give them full knowledge of new machines and methods, and use their brains as well as your own.

(8) You should be prepared to take advice from experts on particular subjects. The designers of the plant and the machine tool manufacturers can help you ; do not regard it as below your dignity to go outside your own plant and seek advice ; go to these people and ask for that advice.

Finally :

Attend Production Engineering Conferences.

The CHAIRMAN said that his colleagues had had a difficult task in presenting in potted form the result of many hours of keen discussion, but they had done it remarkably well. If perhaps one complaint might be made, it would be that such a wealth of information had been presented that the audience must have had difficulty in digesting it all. Mr. Stuchbery had intimated that the proceedings would be printed in the *Journal*, and they would all look forward eagerly to the time when they could read the report and study it thoroughly, putting into operation in their own factories and industries much of the good advice which had been given that morning.

He would like particularly, in thanking the four reporters for summing up so well, to say to them, perhaps as a particular answer to Mr. Stuchbery, that they would not get a financial bonus, but he was sure that the reception accorded to their remarks would be an adequate reward for the trouble which they had taken. In thanking them, he would also like to refer to the three case studies which had been presented the previous evening, which had been very enjoyable and interesting. He would like to thank Mr. Hurst, Mr. Elkington and Professor Immer for preparing and presenting the case studies, which had aroused a keen discussion. He proposed a vote of thanks to them and to the four reporters, which was carried by acclamation.

GREETINGS FROM OVERSEAS

The CHAIRMAN then asked Colonel Warren-Boulton and Mr. S. Downie to come to the platform, and they were greeted with applause when they did so.

The Chairman, continuing, said that one of the sources of strength of the Institution was that not only was it the leading body in Great Britain, but it had very strong links with friends in many

countries overseas. It was a particular pleasure to him, and he was sure to everyone, to have present at least two members of the Institution from overseas, Colonel Warren-Boulton, Past-President of the Calcutta Section and President of the Bombay Section, and Mr. Downie, a Member of the Sydney Section. These two gentlemen had come many thousands of miles to be present at the Conference, and the members welcomed them very warmly. The Chairman asked them to say a few words on behalf of their own Sections so many miles away. On behalf of the meeting, he assured them how glad everyone was to see them, and he asked them to take back a message of goodwill and good wishes to their friends overseas.

Colonel C. G. Warren-Boulton: "No words of mine are needed to express my personal pleasure in being able to be with you to-day and to convey to you in person the greetings of the Bombay Section. I have also the privilege of being requested by my very old friend Mr. Gibson, the President of the Calcutta Section, to convey to the President and all the members his own personal good wishes. Unfortunately, he found himself unable to come here. We expected to have six members present from India ; we have in fact four, two having apparently fallen by the wayside—I imagine that Switzerland and France have their attractions. We are very glad indeed, however, that four of us are with you.

"We in India take great pleasure in the fact that, although our Sections are young, we have been for some time at the top of the membership drive, as you may have seen in the *Journal*. I want to point out that the fact that we are at the top does not mean that in India we admit anyone and everyone; in fact, I am inclined to think that we may be making our standard in India a little too stiff, and perhaps even a little stiffer than yours here, because only about 10 per cent of our applicants get past the first Committee, and out of our last examination we were only able to pass 3 out of 12. The fact that our membership is growing in India must not be taken to mean, therefore, that we are admitting members who are not perfectly competent and good professional men.

"There is an old song called "Following in Father's Footsteps," and in India we see something of that, because Mr. John Warren-Boulton is Secretary—and a very good Secretary—of the Calcutta Section, and coming after him is Mr. Bill Scaife, the son of Mr. J. D. Scaife, a former President of the Institution. Those are the boys who are doing the good work, not we older men.

"I should like to convey to the President and particularly to the staff of the Institution the grateful thanks of the Calcutta and Bombay Sections for the assistance which we have always received from them so willingly. We have much appreciated it, and we hope

that one day either Mr. Woodford, the Secretary, or Mr. Worth, the Education Officer, will be able to pay us a visit.

"Mention has been made this monring of post-graduate courses. We in India have a plethora of universities from which come large numbers of Bachelors of Engineering and of Science. We have come to the conclusion that that is the wrong method of training for industry. We feel very strongly that while a post-graduate course, as you would term it here, after a boy has left the university is, of course, of great value, we want to catch these young fellows before they go to the university, when they are sixteen years old and have matriculated, and let them do two or three years in the shops before going to the university. Rightly or wrongly, we in India are working towards that end. We feel that many of these boys who leave the university with an engineering degree do not want to go into the shop afterwards. In India, they may consider it infra dig. to work with their hands after having letters after their name. In India the Institution is doing very good work in this respect, and we are pushing for more technical schools to which a boy can go after he has left his own school and at which he will be thoroughly trained, or, for preference, that he should go into a works first and not go to a university until he is about twenty years of age.

"As Mr. John Warren-Boulton is present, I should like to ask him to get up and take a bow."

Mr. S. Downie: "I feel that it is a great privilege to be able to come here and attend this Conference. I am a comparatively recent member of our Institution in Sydney. I had hoped earlier that we should have had an appreciable contingent from Australia, but unfortunately the situation has prevented this, and so the task falls to me to express to you the good wishes of our Sydney district. Our President, Mr. E. G. Bishop, expressly asked that I should extend to all who are attending this Conference his very good wishes and hopes for a successful gathering.

"I myself have been most impressed—I think that I could use the word "inspired"—by the character of the whole proceedings of this Conference. I was impressed by the very sincere approach made at the Dinner at the opening of the Conference, and I am sure that we all greatly appreciated the speeches of Dr. Garbett and of our President. They started this Conference off on a very high level, and it is unique, I feel, to have a cleric of the standing of the Archbishop of York to make us realise the very important ethical and spiritual background which lies behind everything that we do. I felt that in itself was enough to ensure complete success for the activities on which we were then about to embark.

"The speakers in the Plenary Sessions have given us outstanding addresses, and it will give me a great deal of pleasure to take back

to our Sydney district an impression of the activities of the Conference and of the words of the speakers, when I have the pleasure of reporting on my trip overseas. The Discussion Groups, as you will have appreciated from the reports this morning, approached their tasks with a sincere and earnest attempt to increase our knowledge and give us a better perspective of the field in which we work. I can have nothing but the greatest praise for the manner in which their work was carried out.

"If there is one impression which I have gained from the Conference, it is that there is definitely a trend—it may be much more advanced than I can appreciate, having so recently arrived in England—to develop the Production Engineer to the top management levels. I think that this is an excellent approach, and that it behoves us all to consider that there are other aspects of our tasks in industry than the consideration of whether to use tungsten carbide tipped tools or some other form. We must feel the need to go beyond the purely technical aspects of our job. The expression which has been used so frequently, that we must consider the common denominator all the time as being the human relations part of our job, and the steps which lead from that to more direct management levels, are matters to which we can give even more attention with profit to ourselves and to our nations.

"You can be assured that I shall take back to Sydney many thoughts, many new ideas and many ambitious impressions of what can be done and of how we can expand our activities in Sydney. I think that this Conference in Harrogate has been one of the finest examples of the excellent results which can be achieved by Conference activities, and I shall certainly press our people out there to carry on with the good work."

This concluded the proceedings of the Third Plenary Session, and the Final Plenary Session followed after a short interval.

Final Plenary Session, 30th June, 1951.

CONFERENCE SUMMING UP

by WALTER C. PUCKEY, Chairman of Council.

THE President, introducing Mr. Puckey, said: "There is one other speaker on whom the limelight in this hall has not yet shone with its fullest blaze. I see at work the people who are responsible for the administration of this Institution, the members of the Finance and General Purposes Committee, the Presidents of the Sections and others, but I see the Chairman of Council at work too. One thing that has shocked me a little at this Conference is that he is dressed a little like a civil servant! He may explain that he had to fly here after keeping an appointment, but I am still slightly shocked by this evidence of slipping on his part. I want to tell you, however, of my conviction that this Institution is extremely fortunate in its Chairman of Council, who is, of course, the man amongst the members who does the work. It is extremely fortunate in having a fine intelligence and a great deal of energy at its disposal, and both these devotedly at its service all the time. Mr. Puckey is going to sum up this Conference, and how he has found the time to do it I do not know."

MR. WALTER PUCKEY

"I have been very much heartened by numbers of friends saying to me during the last few days, and particularly this morning, that they have enjoyed this Conference and that it has been a success.

"I took to heart very much what His Grace the Archbishop of York said to us the other night, that we must regard people as names and not as numbers. Although, in my own small way, I have been trying to do that, I thought that perhaps there were even more ways in which we could take that advice. I therefore said to myself 'If this Conference has been a success, who are the people primarily responsible for it?' and I came to the conclusion that the people that I ought to mention to you now, as being primarily responsible for the success of this Conference, are the members of our own permanent staff. I think you will agree with me that it is only right that they should come on the platform and share some of the limelight that we are having here."

The members of the staff then came on to the platform and were greeted with applause. Mr. Puckey, continuing, said: "Many of you may not have met individually the members of our staff. I

Walter C. Puckey, M.I.Prod.E., F.I.I.A.

Photograph by L. E. Broome

want to say at once that in addition to these ladies and gentlemen behind me there are many who had to be left at Headquarters, and they too shared in the responsibility for the success of this Conference and deserve their share of the praise. I will ask those who are on the platform to rise as I mention their names.

" Mr. Knight—many of you know very well the first-class work that he is doing on the very important educational side of the Institution's activities. Miss Dancer. Miss Mott. Some of you in the audience have already referred kindly to Mr. Worth, our Education Officer, and here he is. Here is also Miss Hubbart, who smiles so sweetly on you when you enter the Institution's Headquarters. Mr. Caselton, whom you all know very well, I am sure. Then Miss Freeman, Miss Keith, and, last but not least, our very efficient and hard-working Secretary, Mr. Woodford. They have done a grand job.

" My wife and I were staying at an hotel recently, and when the time came to leave we had the usual financial discussions and I said " I have not seen any of the chamber-maids." My wife replied " Of course not. They have done their work well and kept out of the way." That put me in my place ! Our staff have done their work well and they have kept out of the way, unless they have been wanted ; when they were wanted they were available and did their job well.

" It is hardly necessary to tell you that they are very young. I hope that they will serve this Institution faithfully, loyally and efficiently for many years to come. We are a young Institution too, and so it is only right that we should have a young staff. Not only are they—and I hope we too—young in years, but they are young in heart. In other words, they have all the most interesting years to come, and I hope that both they and we, in the service of our Institution, will enjoy those years.

" I should also like to thank all those members, and particularly our President, who have helped so much to plan and organise this Conference. It would be invidious for me to mention names, and time does not permit it. They have done this loyal and unselfish job willingly, and their reward has been in your keen interest, and also in what you will do about it when you get back home. We thank them all very much indeed.

Impressions and Recollections

" What will you take away with you when you go home ? You will take away a recollection of some impressive speeches by leaders of industry, and I cannot thank them enough for the public spirit they have shown in coming here. You will take away a recollection of the sparkling give and take at our many Discussion Groups, where we had really live discussions. You will take away with you

the impression that Production Engineering is no narrow concept, no narrow technical practice, but a vital activity linked closely with the prosperity of our country. I think that you will take away with you, and I believe that our visitors particularly will, an impression of upsurging vitality amongst the members of our Institution which will serve it and the country well in the difficult future.

" How can I, in this very short space of time, deal adequately with the whole scope of our Conference ? I do not intend to do so ; I only want to discuss very briefly a few high spots of our Plenary Sessions, because our discussion groups have been dealt with so well by my colleagues that it is unnecessary, as well as impossible, for me to devote any more time to them now.

Emphasis on Human Factor

" I spoke of the grand start we made when the Archbishop of York addressed us. As he spoke, I visualised a notice outside the employment offices of all our factories, " Hands, Brains and Hearts wanted here." He emphasised the essential humanity which should be involved in our technical dealings, indeed in all our dealings with people, and how necessary it is in these difficult times to remind ourselves that we are still dealing with and working through human beings.

" His remarks on the fear of responsibility are all too frequently true. There may be times, however, and I am prepared to admit that I and many others share responsibility for this, when we do not give responsibility quite early enough ; we sour people off ; and so, although occasionally we find a fear of responsibility, let us make certain that, in order to keep young in heart, we also give responsibility early and force it on to people ; when you do that to them it is surprising what they will do for you. The avoidance of responsibility certainly cannot be levelled against our Institution, and most of our members, as well as our staff, do not fear responsibility but gladly welcome it.

" When we reflect upon His Grace's emphasis on humanity, we also remember his criticism that red tape is choking our machinery. As our President reminded you, I am a temporary civil servant, and I apologise for coming in this somewhat sombre garb. I did so because I had to be present at a conference at which the Minister of Supply announced certain restrictions on the use of materials, and then I had to leave and be flown here by the R.A.F. I felt that to turn up at a conference of that kind in a sports coat might be misunderstood, and as at the present time my other suit is being cleaned, I had no alternative but to come here like this.

" As a temporary civil servant I sometimes think of myself as Kipling's Tomlinson, who, you will probably remember, was

doomed for ever to float between heaven and hell, with no clock number at either place. When I heard His Grace talk about red tape, I could not help reflecting—please do not take this as indicating that I am being " got at " inside !—that red tape is not used exclusively by Whitehall. Government practices may all too often reflect our industrial practices. Let us make sure that when we condemn " red tape " we do not regard it as a sin of Government only.

The American Example

" What a fine address we had from Mr. Walter ! We Production Engineers realise, perhaps more than any other section of the community, the necessity for close collaboration with our friends in the U.S.A., and how well does America choose her representatives ! Did you notice his support of the Archbishop of York's thought about taking a personal interest in people ? If I may say so, Mr. and Mrs. Walter have set a fine example, and we are delighted indeed to have them with us during our Conference. Did you notice also—our President commented on it—that Mr. Walter referred to the necessity for a strong personal motive in increasing productivity, while Mr. Lincoln Evans the following afternoon, not having heard Mr. Walter speak, but speaking from his own different point of view, said exactly the same thing ? Here was no collusion, but two leaders of industry, in their different ways, saying exactly the same vital thing.

" Mr. Walter told us that reasonable competition is good for all. Sir Ewart Smith referred also to competition and how vital it can be as an aid to productivity. We liked Mr. Walter's phrase that " if industry did not keep on its toes it would not stand on its feet." Many speakers in the Groups devoted attention to status, promotion and matters of that nature. We were given heart and inspiration by Mr. Walter when he said that the presidents of many businesses in America had risen from a scientific and technical background. He said that they could not be restrained. How much I was reminded of some members of our own Institution !

" We were struck also by his reference to " shirt-sleeve co-operation." I think it was Mr. Batt who was supposed to have used that phrase, but it is a first-class one, and sums up what you and I have to do. One of the greatest assets possessed by a Production Engineer is a knowledge of the men on the factory floor, and a Production Engineer's work can come to fruition only when it is accepted and applied by those people on the factory floor itself. In this respect we differ essentially from many other bodies, and we must never forget that direct link with the British working man.

" Mr. Walter reminded us that in this free world Anglo-American

collaboration is absolutely vital. We hang together or we hang separately. The open door on both sides is in evidence throughout all the activities of the Anglo-American Productivity Teams, and I agree with Sir Ewart Smith that we have a wonderful collection of literature here. Let us examine their reports closely and do something about them. There are also the countless private visits made by members, many of whom are in front of me, to the U.S.A. We have enjoyed American hospitality on many occasions, and we hope that it will long continue. We also welcome Americans visiting us, and we are sure that there are many things which they will learn from us, as indeed Mr. Walter said yesterday. A few people may say that we have enough to learn from our own best firms, but let us remember that the average productivity in America is two to two and a half times ours, and we as Production Engineers cannot afford to neglect that fundamental fact.

Evidence of Collaboration

" I was very interested, as I am sure that you were also, in the statement by Mr. Walter that several first-class Production Engineers are being made available here for intimate consultation on some of our own problems. I know that in the aircraft industry, for example, a tremendous amount of collaboration is going on in, for instance, the production of jet engines. That is one example out of many where this close collaboration can take place. We shall welcome these first-class American Production Engineers here ; we want their help, and British factories and British doors will be open to them. I assure Mr. Walter that the Institution will work very closely with him on these matters and will follow up the possibilities of this scheme, possibly in collaboration with the new advisory panels which are being set up jointly with industry and the Ministry of Supply.

" The statistics which Mr. Walter gave us on the number of graduates demanded by industry in the United States were very impressive, and his reference to the great need for more trained Production Engineers was repeated in many forms during our Group discussions. Here indeed we have a good record as an Institution, but how much more there is still to do.

" In the afternoon we had talks by Sir Norman Kipping and Mr. Lincoln Evans. Did you notice the skill shown by those two gentlemen in making speeches so complementary to each other ? Sir Norman Kipping painted on a broad economic canvas, as befits his present job. As a temporary civil servant, I agree with him that industry should impose tasks on itself rather than have them imposed on it, and I hope that industry will more fully accept that challenge. Many companies still have a managerial closed shop, or perhaps a closed mind. We have to accept even more

fully the sort of challenge put out by Sir Norman Kipping. If industry does not do its own job, of necessity Government will step in to fill the gap.

" I think that Sir Norman was a little complacent about the sales of A.A.C.P. reports. He said that they had sold 350,000. We have in this country alone, quite apart from the demands from overseas, some 20,000,000 people gainfully employed ; that is about 60 people per copy sold. I am sure that all of you here have read these reports, but how many of our 8,000 members have studied them and are working hard to do something about them ? It is a challenge which we might well take up when we go home again.

The Industrial Load

" I hope that you realised the full significance of Sir Norman Kipping's remarks about our present industrial load. He said that in the five years 1939 to 1944 we increased our production—not our productivity—by about 43 per cent. Today, he said, we have little reserve of man-power or materials, and these fundamental facts, in the face of our economic necessities and our rearmament programme, are worrying us very much. I could say a great deal on this point, because it is one which is worrying me tremendously at the present time, when we have load superimposed on load, and very little reserve indeed to bear it all. You may well ask whether we can or should shed some of this load. Sir Norman told you that we should not shed it on electricity generation, and Sir Ewart Smith talked this morning about the coke position, so you will see that in many ways it is fundamental to keep up a very high rate of production of certain essential services in this country ; but something has to happen if we are to maintain and possibly to increase our rearmament programme.

" Sir Norman emphasised, however, that there is no limitation on " productivity " except our own failure to achieve what is really necessary, and in this fight, we not only fight indeed for an increase in productivity but for the maintenance of our standard of life. The stakes are very high.

Labour and Productive Efficiency

" What a fine address we had from Mr. Lincoln Evans ! Here we had a labour leader advocating production efficiency in a manner not thought possible even a few years ago. Many of us, sometimes, complain that our own people, or more usually somebody else's people, down on the working floor do not fully understand the need for productive efficiency, but here we have a labour leader strongly advocating it. How many of us would like to be in Lincoln Evans's shoes, to take over the job of boldly proclaiming

the great need for production efficiency and at the same time having the tremendously difficult job of selling this right down the line. Let us help him in the difficult task of educating more and more workers to accept this necessity.

" How right he was when he said that productivity is not only a matter of improving processes, but an attitude of mind, a new philosophy. We have to get this attitude of mind into the heads and hearts of our people. Once again it is a question of getting the other fellow to understand Why, just as you or your wife want to know Why. If you know Why, you will go and do something. If the other man knows Why, he will go all the way with you.

" It has been said, and perhaps emphasised this morning in yet another form, that there are no bad privates ; there are only bad Generals. Incidentally, we have a very good one.

" Now I come to the last speaker at our Plenary Sessions, Sir Ewart Smith. Your own applause and welcome to him this morning show how much you appreciated his grand address. As the President said, he also painted on a very broad canvas, and, as his address is so fresh in your minds, I shall not attempt to comment in any detail on it ; I should, however, like to mention one or two features which impressed me particularly.

Importance of Self-Criticism

" First, he said that we must be self-critical. We certainly are, and I hope that we continue that way. Secondly, he said that the key to the standard of life is our industrial efficiency. Let us try to forge that key and machine it and turn it. He said, and emphasised many times, that we must accept managerial responsibility for most of the problems confronting us. He said also that it was time that we took the blinkers from our eyes regarding our chances of emulating American productivity performances. How true that is. He also emphasised the sort of real training necessary to produce real managers.

" If I can add just a very small comment here, I was glad to hear him define, better than anyone else has, just what is meant by this new term " work study." I did not know before exactly what it meant and assumed it was merely an old occupation in a new dress. I have been studying work for years, and I do not like the look of it ! Sir Ewart wound up by giving us his philosophy on the whole subject, when he discussed the claims of each interested communal group, and how we should attempt to satisfy them all. We certainly agreed that it was a grand address.

" I attended most of the Group meetings for a very brief period, but I cannot comment adequately except on what seemed to be the concentrated purpose of all those present. I hope that many members will take away much of value on the essential technical

side of our work. Let our junior members in particular never forget that in mastering perhaps a rather narrow technical job, they are all the more likely to grow into full manhood in our great profession and take wider views and wider responsibilities.

The Future of the Institution

" Finally, a few words about the future of our Institution. How good it is to see so many of the early pioneers at Harrogate—men like Hancock and Fraser, whom I am so glad to see here, must be proud to see how what was once a tender plant has grown to greater stature. We are not yet in full flower, possibly we never shall be, as we shall continue to grow for many years to come. To the Graduates here I will say this. If you can in future years look back, as these men can look back, on years of sacrifice and hard, selfless work for our Institution, for the community and the country, you will have the same right to be proud as these men have.

" You heard our President at Dinner talk about some of the things that will further enhance the value of this Institution to the country. He referred to the appointment of a Technical Officer to supplement the work being done by the other members of the staff. He referred to our new Institution Papers, and he mentioned the possibility of larger premises, and things of that nature. This is not the time to talk adequately about those things. Sir Ewart Smith said that it is not so much where we are as where we are going that matters, and we are going places : you can take that from me.

" These things that I have just mentioned are all practical things, but the real capital of our Institution is not so much in those things ; they are only the symbols of our value. What a wonderful opportunity our younger members have and how lucky is the young Production Engineer ; he is nearer to the shop floor and to the hearts of men than any other group. Let him study all the techniques of training and all the wisdom of those who have spoken here, and let him realise that through the will and through the interest of men all things are possible.

" Twenty years ago, perhaps a free society believed that it had solved the problems of production and that only the problems of distribution remained. Recent experiences have shown that that trend is being reversed, and we believe more fully now in the great importance of production. The task of the next half-century is to show the world that the West, and perhaps Britain especially in the West, can practise this faith. It is not enough that our Western world is free and just ; it must also be economically rich, and it must achieve these things under very difficult conditions.

Challenge from the East

" We face—let us admit it—a challenge from the Eastern world to our philosophical outlook, and we face internally the problems arising from, I was going to say, over-full employment, the under-supply of many materials, and the great strain on our economic life through such expensive necessities as the duty to keep ourselves strong. One thing is certain : this generation will shape the lives of many generations to come. There is no reason for despair ; such a challenge will be accepted by our nation, as it has been in the past, and in the shaping of our future destiny as a nation, you and I believe that our Institution will play a great part.

" I hope you have not regretted these few days off from your busy tasks to come to Harrogate. I hope that you will go home mentally and physically refreshed, and that you, your ladies and our guests will say, when you go home, ' That was a good Conference'."

The proceedings then terminated.

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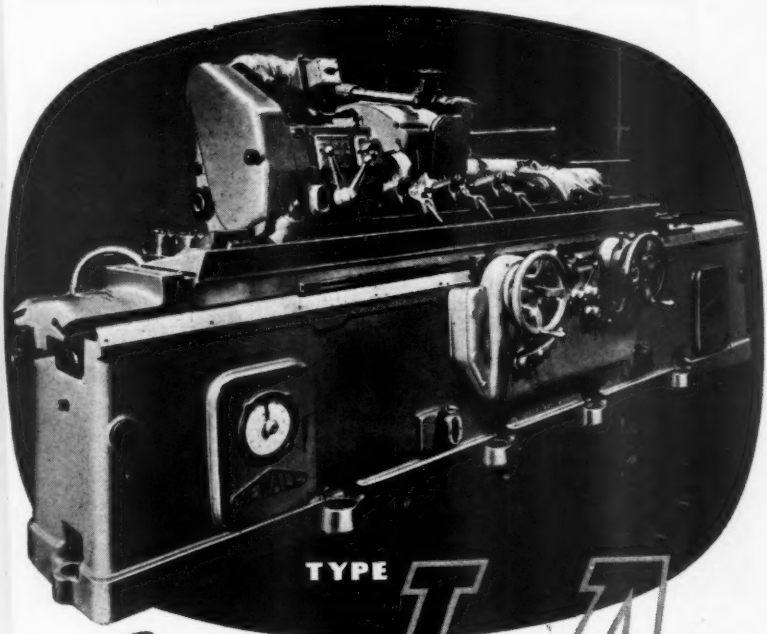
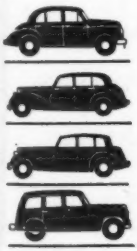


TYPE LA

Grinding machine

NEWALL "LA" GRINDER CAPACITY 16" x 60"



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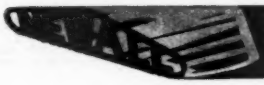

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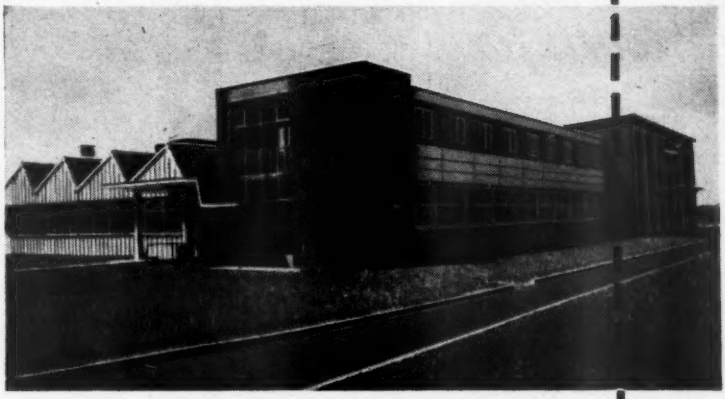

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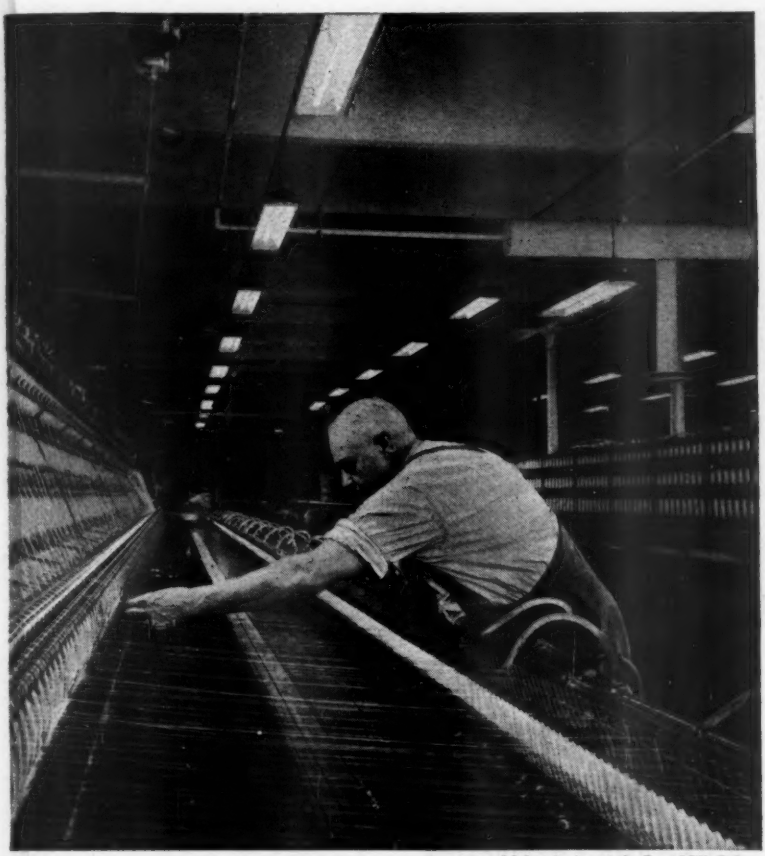

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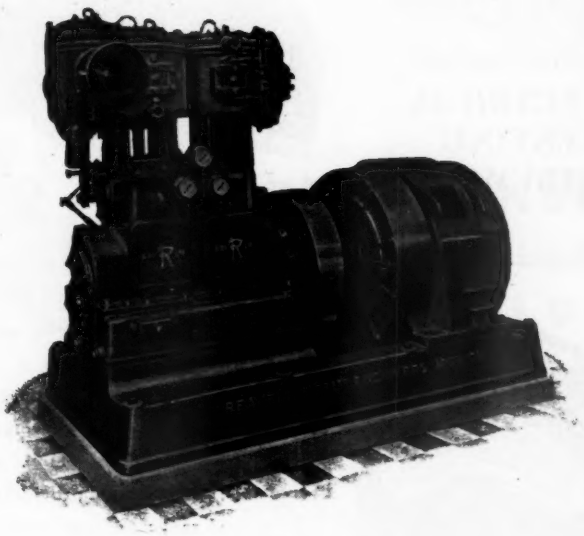

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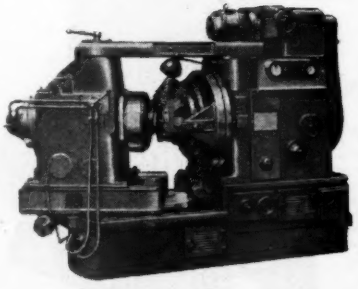

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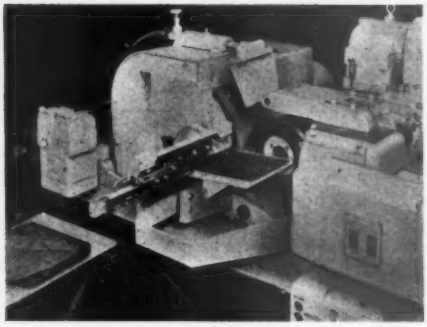

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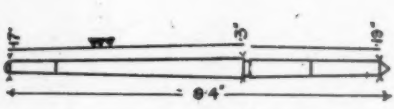

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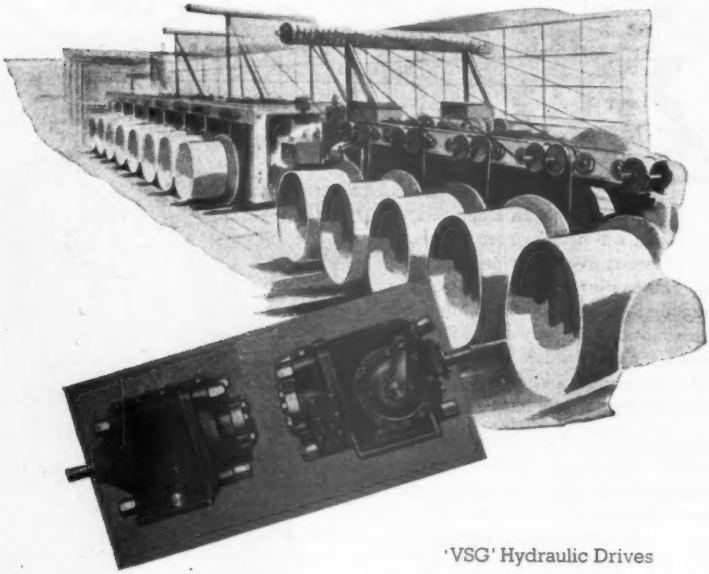

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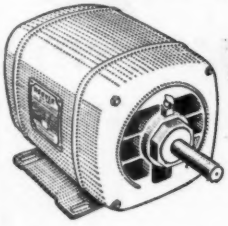


HOOVER LIMITED

INDUSTRIAL PRODUCTS DEPARTMENT

CAMBUSLANG · LANARKSHIRE · SCOTLAND

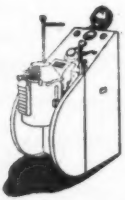
Deep in the forests of Central and South America roams the ant-eater — although he eats plenty of other insects besides. If ever an animal was perfectly designed to do the job, this is it. With his large bushy tail he shades himself when resting in the sun by curling it round him. With his strong front claws he tears away termites' nests, and with his long, thin head and sticky tongue he ferrets out the ants themselves for breakfast, lunch and tea. (They don't have dinner in the South American jungles.)

perfectly designed to do the job

The Wild-Barfield Electrode Salt Bath also does the job perfectly. Using different salts for different ranges, temperatures can be maintained between 550°C. and 1350°C. In the high temperature ranges greater rapidity of heating is achieved than by any other method, and the protective nature of the salt ensures a clean finish and freedom from decarburisation. Perfect in fact for pre-heating, hardening, quenching and secondary hardening of high-speed steels; hardening carbon and low alloy steels; cyanide hardening; brazing etc.

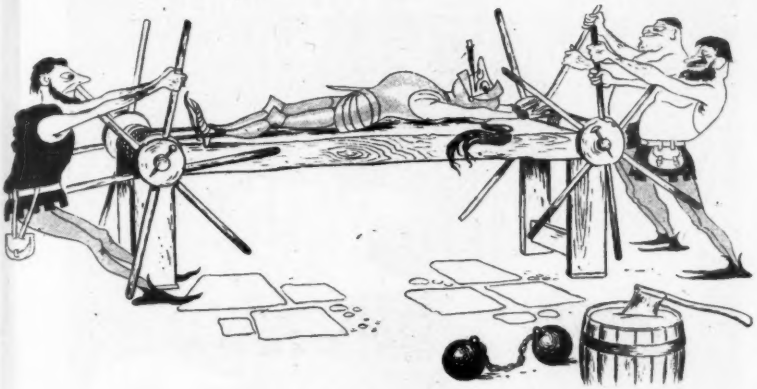
Wild-Barfield

Electric Furnaces



FOR ALL HEAT-TREATMENT PURPOSES

WILD-BARFIELD ELECTRIC FURNACES LTD., ELECFURN WORKS, WATFORD, HERTS. PHONE: WATFORD 6094 (4 LINES)



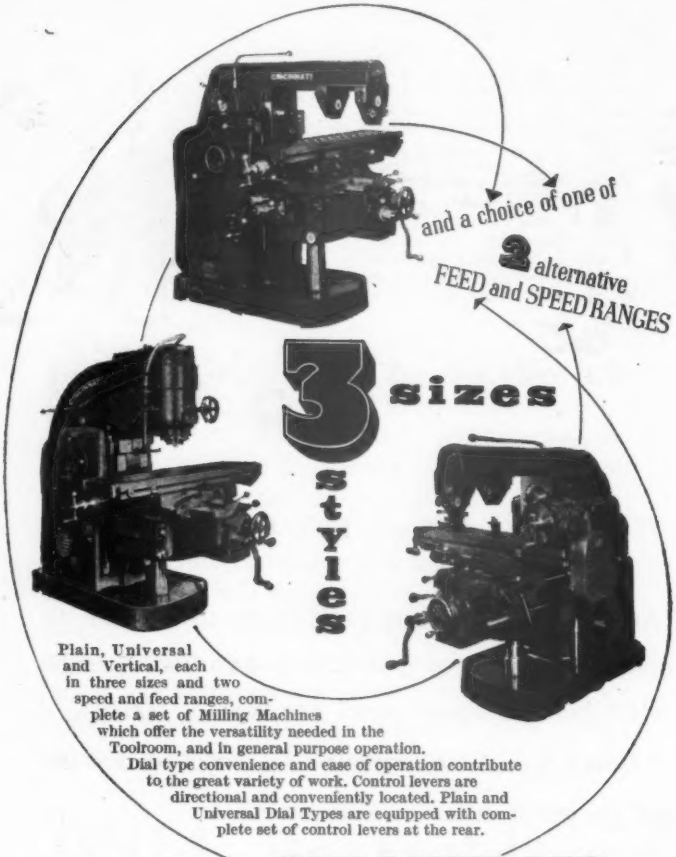
TENSILE STRENGTH

An obvious advantage of MAZAK for the pressure die casting of stressed components is its high tensile strength (18·5 tons per square inch.) The basis of MAZAK is "Crown Special" Zinc of 99·99+% purity which is one of the purest metals commercially available.

MAZAK

IMPERIAL SMELTING

IMPERIAL SMELTING CORPORATION (SALES) LTD., 37, DOVER STREET, LONDON, W.1



Plain, Universal and Vertical, each in three sizes and two speed and feed ranges, complete a set of Milling Machines which offer the versatility needed in the Toolroom, and in general purpose operation.
Dial type convenience and ease of operation contribute to the great variety of work. Control levers are directional and conveniently located. Plain and Universal Dial Types are equipped with complete set of control levers at the rear.

CINCINNATI
DIAL TYPE
MILLING MACHINES

Specifications with details of additional equipment available on request.

CINCINNATI MILLING MACHINES LTD.
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Sales Representatives for Gt. Britain and Northern Ireland: Chas. Churchill & Co. Ltd., South Yardley, Birmingham, 25.

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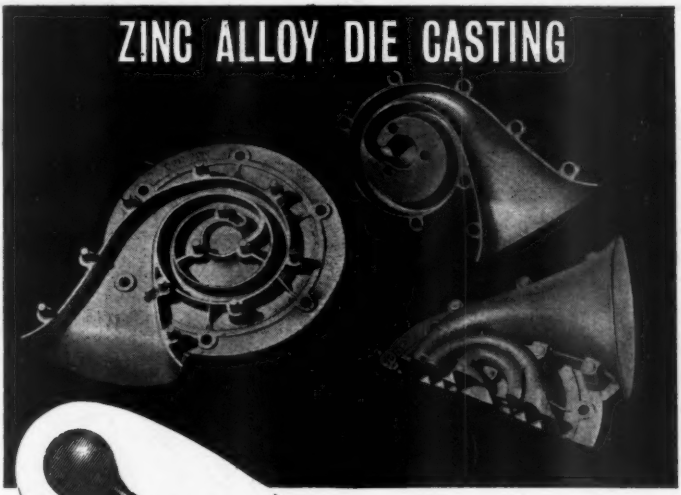
ZINC ALLOY DIE CASTING



makes all the difference!

The simple brass bulb horn was essential to early motorists, who gave it a proud position on their machines; and Africans valued them so much that they hoarded them instead of money! But ideas changed, and modern horns are so complex that they are only economical when they are zinc alloy die cast.

The windtone horn shown above is one of a pair that sound in harmony. Each is a good example of an intricate geometrical pattern which has been faithfully reproduced by die casting. The two parts of each horn are held tightly together by integral rivets on one engaging with cored holes on the other.

Some facts about zinc alloy die casting

Speed of production is an outstanding feature of the die casting process — the shortest distance between raw material and finished product. Zinc alloys are the most widely used of all metals for die casting because they yield castings with the following qualities :

ACCURACY: Castings can be made practically to finished dimensions and need little or no machining.

STRENGTH: Good mechanical properties for stressed components.

STABILITY: Close tolerances are maintained throughout the life of the casting.

British Standard 1004

It is essential that alloys conforming to B.S.1004 should be specified for all applications.

The Association welcomes enquiries about the use of zinc alloy die castings. Publications and a list of Members are available on request.

ZADCA **ZINC ALLOY DIE CASTERS ASSOCIATION**

LINCOLN HOUSE, TURL ST., OXFORD

Photograph reproduced by courtesy of Joseph Lucas Ltd.

STELLITE for Stainless!

Stainless Steel—

is an alloy on its own. Machining generates more heat than most alloys and because Stellite does not soften with heat, production can be trebled. Stellite tools are tough to give long life and freedom from chipping, yet their cost is moderate.

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DELORO STELLITE LTD., HIGHLANDS ROAD, SHIRLEY, BIRMINGHAM

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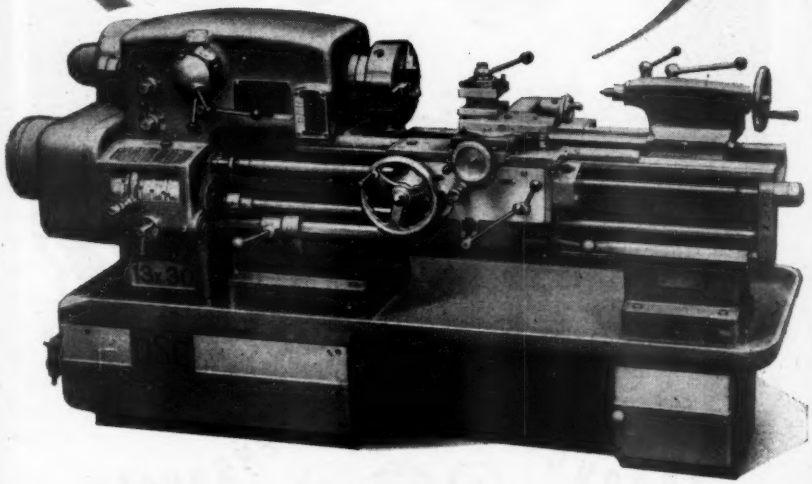
166

TIPPED TOOLS • TOOLBITS • TOOLTIPS • MILLING CUTTER BLADES • HARDFACING ROD • WORKRESTS • PRECISION CASTINGS

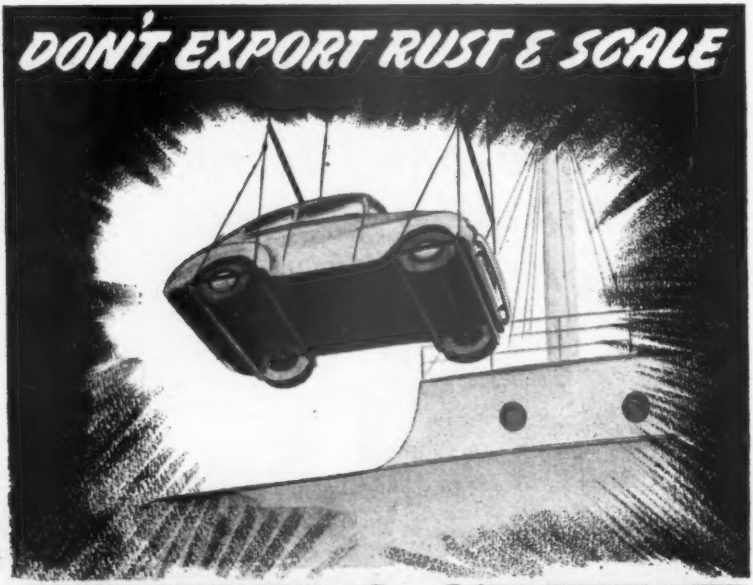
DSG
LATHES

have been turning the World over for 86 years....



Dean Smith & Grace
KEIGHLEY · Limited · ENGLAND

DON'T EXPORT RUST & SCALE



FERROCLENE REGD.

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PRODUCTION PROVED PRODUCTS

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ELECTROLYTE WORKS, 9a LADBROKE GROVE, LONDON, W.11
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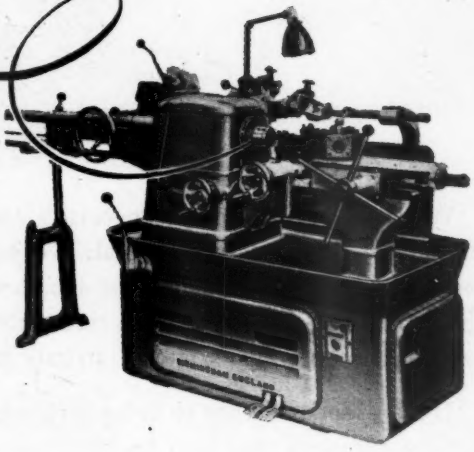
OVERSIZE COLLET CHUCK
on the
TIMBRELL & WRIGHT CAPSTAN LATHE



One of the most useful accessories in the Timbrell & Wright Capstan Lathe equipment, the Oversize Collet Chuck is lever-operated through the ordinary collet mechanism. All working parts are hardened and ground.

One Master Collet may be used for any number of pads made to suit various jobs.

For particulars of T. & W. Capstan Lathes and equipment apply to :—

The Sole Selling Agents:

CHARLES CHURCHILL & CO. LTD

COVENTRY ROAD, SOUTH YARDLEY, BIRMINGHAM

Also at LONDON, MANCHESTER, GLASGOW and NEWCASTLE-ON-TYNE

THE SCRAP ZINC MENACE

in die-castings..

While we appreciate the necessity to recover every pound of the scarce non-ferrous metals, we cannot refrain from reminding users of high quality zinc alloy pressure die castings that the fact still remains that such castings can ONLY be produced by using alloys which conform strictly to B.S.S. 1004.

The present tendency to bring into use doubtful alloys makes it more necessary than ever for purchasers of zinc alloy pressure die castings to ensure that the pressure castings which they buy do in fact strictly conform to B.S.S. 1004.

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ELDAIR is the last word in medium priced power Metal Bending Machines. It speeds production and lowers the cost, and is essentially a practical, precision tool invaluable to the sheet metal manufacturer.

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We have pleasure in announcing that we are now producing gyro balls and bearings. We are also producing miniature steel balls .003" in diameter in addition to our present range of Grade A25 and A1 balls.

Synthetic sapphire, ruby and agate balls are also produced in similar sizes and grades.

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All our products are entirely of British manufacture and are fully A.I.D. approved.

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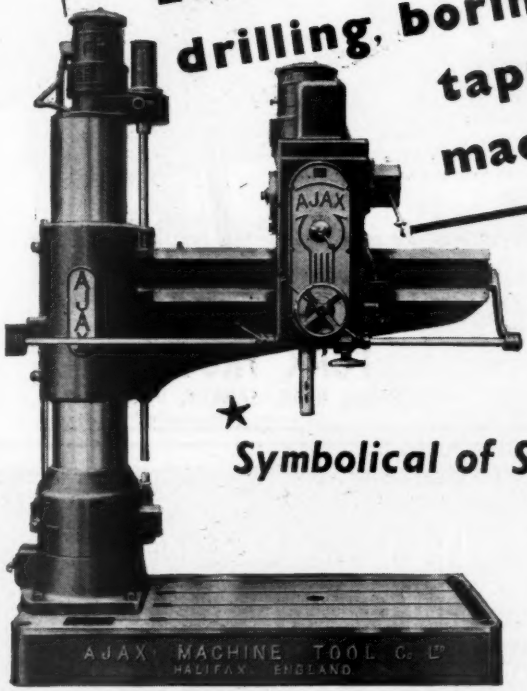
★ AJAX radial drilling, boring & tapping machine



★ *Symbolical of Strength*

4′6″, 5′ and 5′6″ sizes 3′, 3′6″ and 4′ saddle traverses 8 speeds in choice of 3 ranges 4 rates of power feed at each speed 1⅛″ dia. spindle with 14″ feed 3″ capacity in cast iron.
Completely electrified.
No friction clutches.

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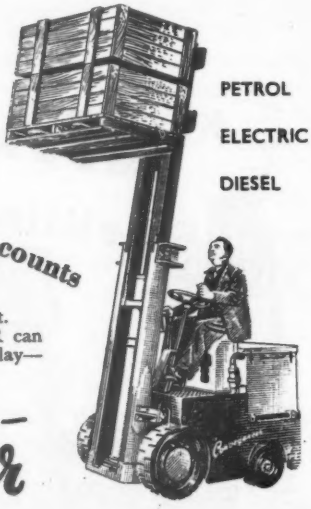
Ajax Machine Tool Co. Limited.
West Mount Works, Halifax, Yorks.
Proprietors: ADA (Halifax) Ltd.

AJAX MACHINE TOOLS

The invisible load—

is the one that counts

The load which does not show in the production accounts is the high cost of moving materials by hand, which has been estimated at 15 to 85% of the total production cost. When one man and a CONVEYANCER can comfortably move 300 tons in a working day—



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Can you afford not to use—

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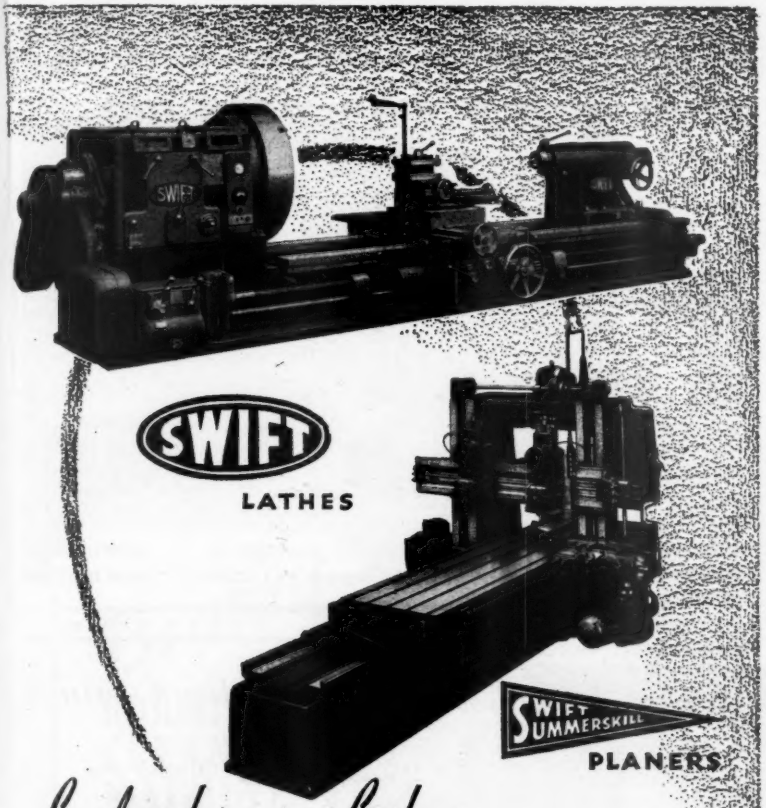

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Perfection in Planers

SWIFT LATHES are built as both Centre Lathes and Surfacing and Boring Lathes, and range from 17in. swing to 72in. swing, with any length desired between centres.
SWIFT-SUMMERSKILL PLANING MACHINES are built from 2ft. 0in. square up to 6ft. 0in. square, of any length of table up to 40ft. 0in., of both Double Column and Openside types, with either all Electric or reversing Two Belt Drive. Special All Electric Feed Motion.

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It is small- but does a man-sized job

IF your small work includes grinding, turning, boring or milling.

IF you realise the imitations of ordinary machines

IF you require adaptability, precision overall economy.

THEN—You need PULTRA Multi-purpose Equipment in your works.

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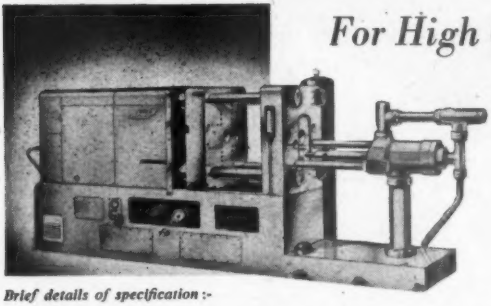


For High Quality Castings

Model 10c
DIE-CASTING MACHINE

Brief details of specification :-

Capacity	**8½ lbs. (in Aluminium)**
Plunger diameters	**1¾ to 3½ ins.**
Pressure on material ...	**6,150-23,000 lbs. sq. in.**
Locking pressure	**450 tons**
Platen dimensions	**35½ x 35 ins.**
Maximum die space	**25 ins.**

We have pleasure in introducing a new British-designed and British-built Cold Chamber Die-Casting Machine.

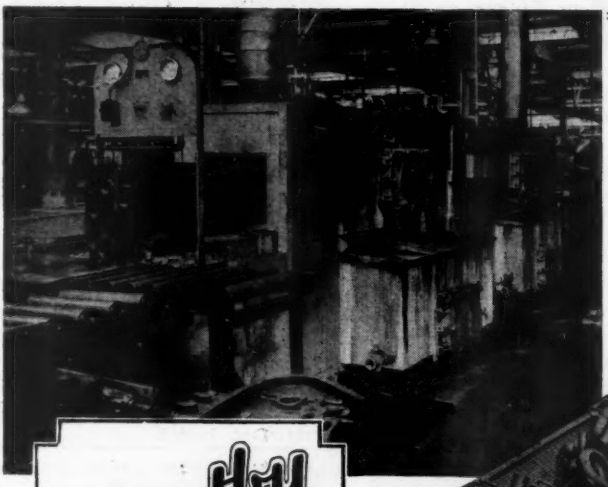
The machine is self-contained, hydraulically operated, suitable for hand or semi-automatic operation. The machine is also fitted with hydraulic ejection and provision is made for automatic interlocking core-pulling.

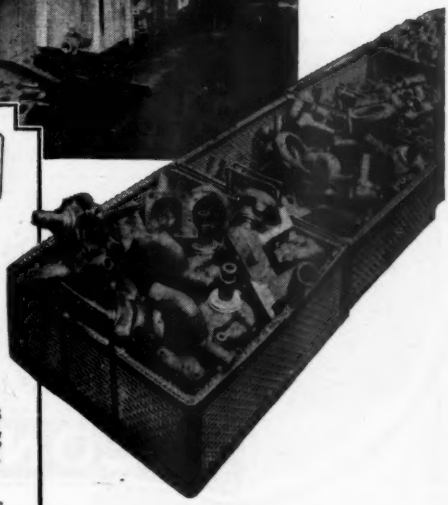
Please ask for full particulars explaining the many interesting features of this machine.

The PROJECTILE & ENGINEERING Co. Ltd.

Telephone: MACAULAY 1212. **ACRE STREET, LONDON, S.W.8.** *Telegrams:* Profectus, Claproad, London.

Each cleaning problem studied individually





Bratby

INDUSTRIAL CLEANING MACHINES

This illustration shows a machine cleaning crank cases in the production line.

It is equally capable of cleaning small parts in baskets.

Photographs by courtesy of "Machinery."

Sole Agents for Great Britain :

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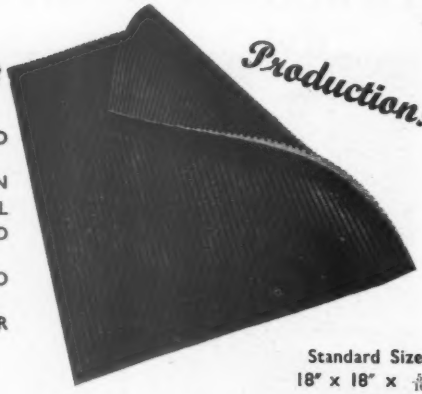
Designed and manufactured by :

BRATBY & HINCHLIFFE LTD., SANDFORD STREET, ANCOATS, MANCHESTER 4

VULCASCOT ANTI-VIBRATION PADS

VULCASCOT
REG'D. TRADE MARK

Improve *Production!*



- CHECK VIBRATION SHOCK AND NOISE
- COMBAT NERVOUS STRAIN
- ARE EASY TO INSTALL
- SAVE MAINTENANCE TIME AND COST
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EXPERIENCE & DEVELOPMENT IN HIGHEST QUALITY STEELS OF ALL GRADES

As manufacturers of Alloy Steels for High Duty, Firth Brown's contribution to industry is world wide, whether it be steels for engineering, shipbuilding, automobile, aircraft, road and rail transport or for the most minute mechanisms of the precision engineering industries Firth Brown Steels are used in the gear box assembly of the A 40 by the Austin Motor Company Limited.

LIST OF PRODUCTS

Forgings—Light and Heavy, for special and general engineering.

Forged Steel Drums, and Pressure Vessels.

Hardened Steel Rolls.

Carbon and Alloy Steel Bars and Billets.

Tyres and laminated Springs.

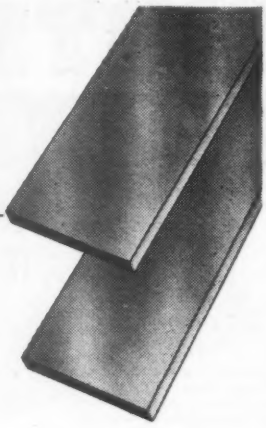
High Speed and Tool and Die Steels.

Steel Castings.

Write for the Firth Brown Buyers' Guide for further particulars.

THOS. FIRTH & JOHN BROWN LTD., SHEFFIELD

Precision Ground FLAT STOCK



18" standard lengths and special lengths. 'Pitho' non-distorting oil hardening steel. Ideal material for precision tools, gauges, jigs, templates and for many types of punches and dies.

A SABEN PRODUCT

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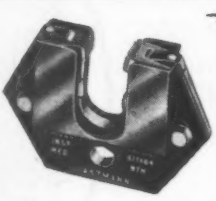
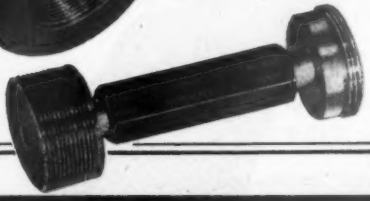
ATTERCLIFFE STEELWORKS SHEFFIELD

GAUGES *of reliability* HORSTMANN



Guaranteed for accuracy and precision



The comprehensive range covers Screw, Plain, Plug and Ring types, as well as the Horstmann patent adjustable Screw and Plain Caliper Gauges.

They are guaranteed for accuracy, finish and hardness to N.P.L. requirments and are in great demand.

GEAR HOBS.
A full range is available

THE HORSTMANN GEAR CO. LTD.
NEWBRIDGE WORKS, BATH, ENGLAND. TEL: 7241

ask your moulder...

This is the third in a series of announcements designed to assist Buyers in purchasing plastics moulded articles or components.

You work to a price limit, and you wish to purchase as economically as possible. But a figure is no more than a conventional symbol. Mouldings bought 'cheaply' may prove extremely expensive; on the other hand a little additional expenditure may save many pounds in the long run.

An actual case in point is that of a large works where production was found at a standstill, the operatives sewing, knitting and reading. The Buyer explained the reason. For many years he had bought a tiny moulded component from a moulder who had given every satisfaction. The price of this component was 2¼d. but a rival moulder quoted 2¼d. and the Buyer was instructed to change his supplier. When the new mouldings were issued for use, after weeks in stock, they were found not to fit.

To ensure against such hold-ups, either the customer must inspect every moulding on delivery, or the moulder must inspect it *before* delivery. Obviously the wiser plan is to choose a moulder who provides a meticulous system of inspection as a regular feature of his service. You are entitled to expect this, so do not fail to ask your prospective moulder about it. Good inspection service ensures a very low reject rate at your end and means true economy, even if the quoted price should be slightly higher than others.

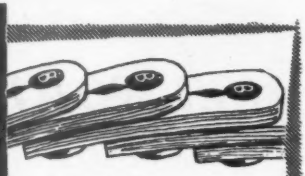
The G.P.O. terminal strip embodies 45 moulded and 165 metal parts. It was assembled on a moving belt conveyor system. Every moulded component was inspected twice during assembly and the completed strip electrically tested before leaving the works. Moulding and assembly by The Streetly Manufacturing Co. Ltd. for The Engineer-in-Chief, Post Office Engineering Branch.

If in doubt, ask **STREETLY**

The Streetly Manufacturing Co. Ltd. makes mouldings in thermosetting and thermoplastic materials and specialises in long runs of the highest quality mouldings. A high percentage of its regular output is of mouldings for manufacturers of electrical equipment and accessories. If you have a moulding job in view, call in Streetly for practical, down-to-earth advice.

THE STREETLY MANUFACTURING CO. LTD., STREETLY, SUTTON COLDFIELD, Nr. BIRMINGHAM
TELEPHONE: STREETLY 78411. TELEGRAMS: BANG STREETLY

B·I·P GROUP



BRAMMER

- The adjustable V-link belt for all power drives.
- Fitted without dismantling machinery.
- 5 sizes of BRAMMER will replace 295 standard sizes of solid ropes.
- No distortion when flexed round small pulleys.
- Essential for fixed centres.
- Will replace any solid rope.

Send for catalogue now.

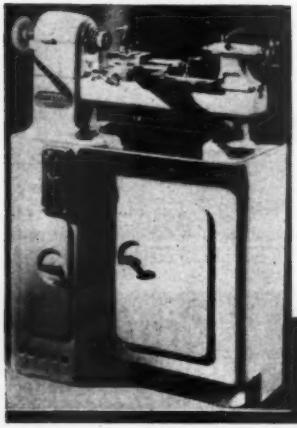
BRAMMER V LINK BELTING

H. BRAMMER & CO. LTD. • LEEDS 9

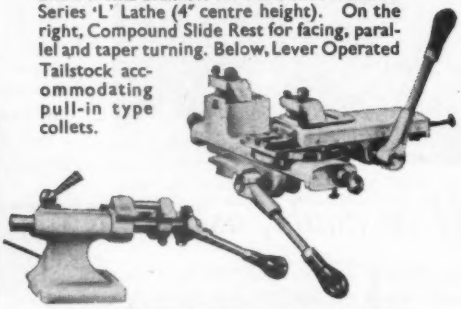
CANADIAN SUBSIDIARY: H Brammer Canada Ltd., 3524 St. James Street West, Montreal

Sole Manufacturers and Patentees

FROM **TOOLROOM** *TO* **PRODUCTION** *WITH THE AID OF ATTACHMENTS*



Here are two of the many interchangeable attachments available for the Smart & Brown Series 'L' Lathe (4" centre height). On the right, Compound Slide Rest for facing, parallel and taper turning. Below, Lever Operated Tailstock accommodating pull-in type collets.



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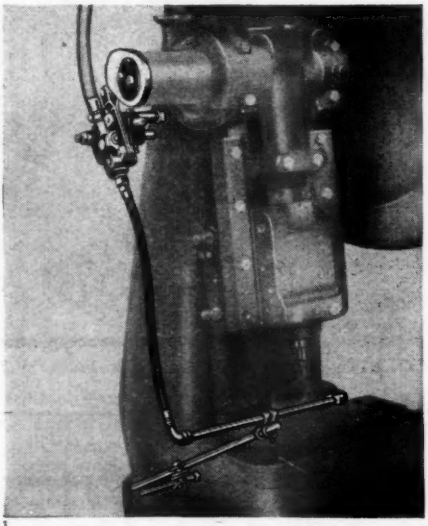

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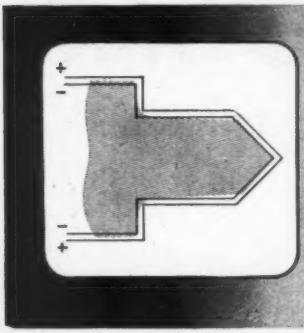

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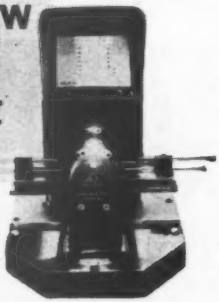

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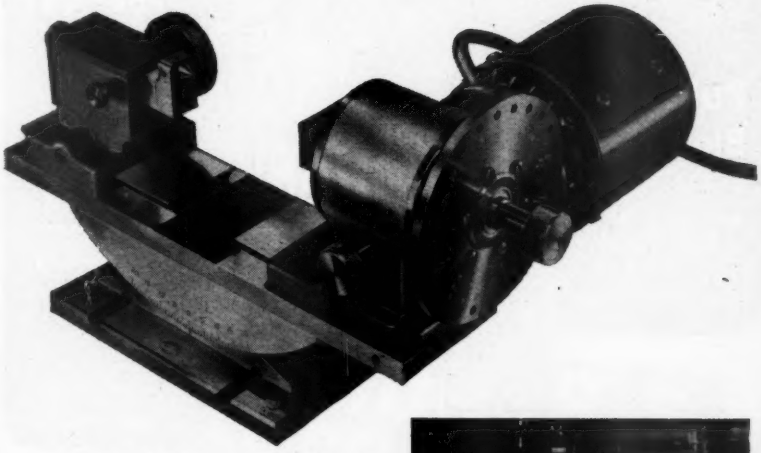

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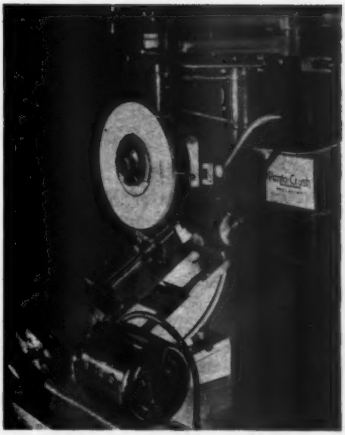

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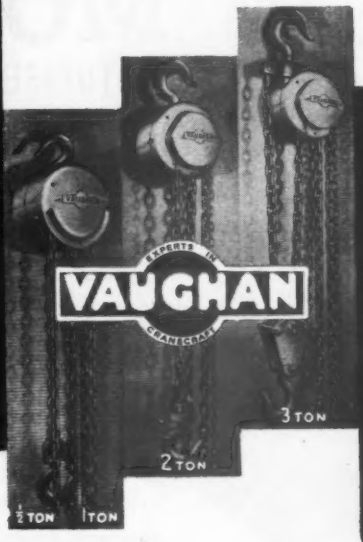

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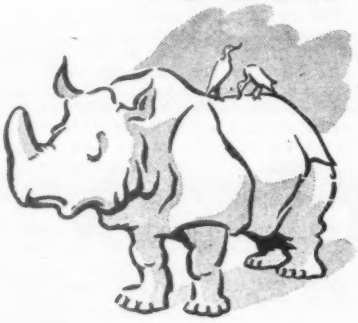

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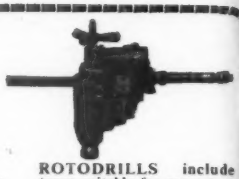

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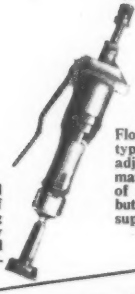

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